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CONNECTICUT RIVER BASIN LYNDON, VT

INSTITUTE POND DAM VT 00216

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM





DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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DECEMBER 1980

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DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO ATTENTION OF:

NEDED

APR 0 6 1981

Honorable Richard A. Snelling Governor of the State of Vermont State Capitol Montpelier, Vermont 05602

Dear Governor Snelling:

Inclosed is a copy of the Institute Pond Dam (VT-00216) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, Philip Mathewson, Lyndon Center, Vermont 05850.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely.

Incl As stated C. E. EDGAR, III

Colonel, Corps of Engineers

Division Engineer

NATIONAL DAM INSPECTION PROGRAM PHASE I - INSPECTION BRIEF ASSESSMENT

Identification Number:

VT00216

Name of Dam:

Institute Pond Dam

Town:

Lyndon

County and State:

Caledonia, Vermont

Stream:

Passumpsic River tributary

Date of Inspection:

September 30, 1980

Institute Pond Dam is a 250-foot long, 26-foot high earth embankment with an upstream slope of 2.6H:1V and a downstream slope of 2.6H:1V. A 10-foot wide, 106-foot long concrete chute spillway with crest elevation 4.5 feet below top of dam is located near the right abutment. The spillway is ungated. __ate Aid Highway 9 divides the impounded water. The two ponds, pond #1 (downstream) and pond #2 (upstream) are connected by a 48-inch diameter culvert which runs under the road.

Visual inspection of the dam indicated the dam is in poor condition. The inspection revealed potential structural problems, such as, the encroachment of flora growth on the earth dam, an actively discharging seepage area at the toe of the dam and the erosion of the concrete on the chute spillway.

Based on the small size of the dam and its High hazard classification and in accordance with Corps of Engineers Guidelines, the test flood inflow should be of a magnitude ranging from the $\frac{1}{2}$ Probable Maximum Flood to the Probable Maximum Flood (PMF). The PMF was used for the test flood inflow resulting in a discharge at the earth embankment of 726 cfs, at which time the dam would be overtopped by 0.7 feet. With a water level at the crest of the dam, the capacity of the concrete chute spillway is 305 cfs which is 42 per cent of the routed test flood outflow. Furthermore, in routing the PMF test flood for the upper pond, pond #2, through the 48-inch culvert, the road embankment (State Aid Highway 9) would be overtopped by 2.7 feet.

The owner should engage a qualified registered engineer to investigate the seepage problems of the earth dam and the discharge capacity of the project. Other recommendations and remedial measures are described in Section 7 and should be addressed within one year after receipt of this Phase I Inspection Report.

Very truly yours,

DuBois & King, Inc.

Robert J. Wernecke, P.E.

fert & Wernicke

Project Manager

RJW/ta Attachments



This Phase I Inspection Report on Institute Pond Dam (VT-00216) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR. MEMBER Water Control Branch Engineering Division

Chance Contin

ARAMAST MAHTESIAN, MEMBER Geotechmical Engineering Branch Engineering Division

Carney M. Vergian

CARNEY M. TERZIAN, CHAIRMAN Design Branch Engineering Division

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APPROVAL RECOMMENDED:

In B. Fuyan

JOE B. FRYAR

Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these Guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably-possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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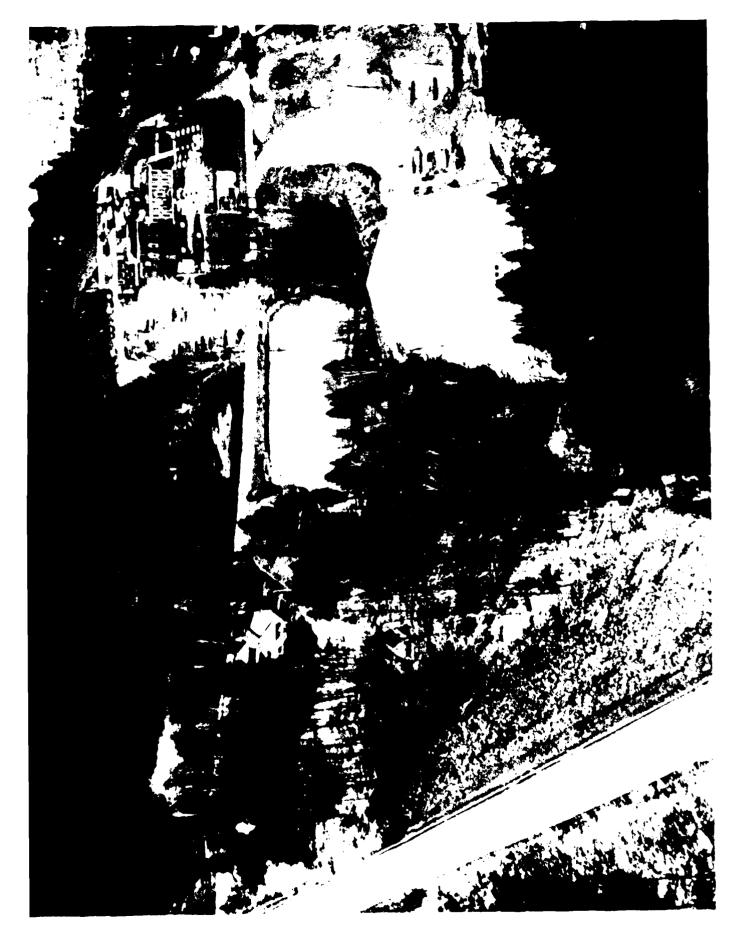
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APPENDIX B - ENGINEERING DATA

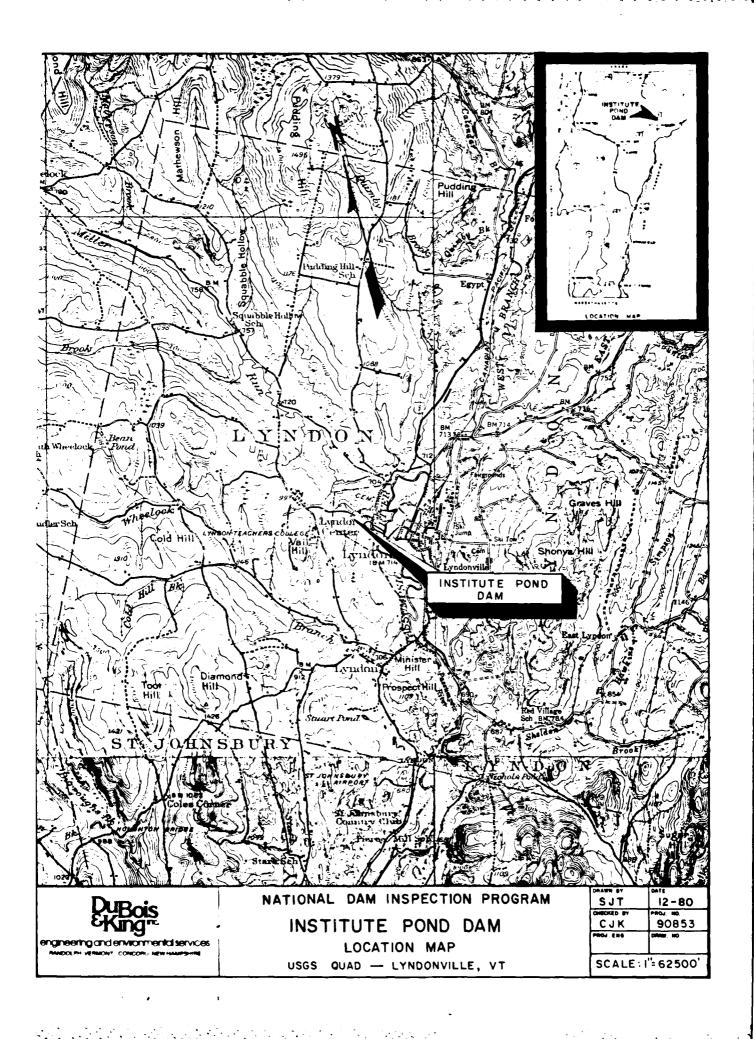
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OVERVIEW PHOTOGRAPH - INSTITUTE POND DAM



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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin Lyndon, VT.

Passumpsic River Tributary

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a 250 ft. long, 26 ft. high earth embankment with an upstream slop of 2.6H: 1V and a downstream slope of 2.6H: 1V. The dam is in poor condition. The inspection revealed potential structural problems. It is small in size with a high hazard potential. The owner should engage a qualified engineer to investigate the seepage problems of the earth dam and the discharge cpacity of the project.

SECTION 5 EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Institute Pond Dam is an earth dam with a length of approximately 250 feet and a structural height of 26 feet. The appurtenant works consist of a concrete chute spillway 10 feet wide and 106 feet long. There is also a concrete valve box on the downstream toe of the dam which controls an unknown sized drainage system for the dam.

The spillway has an ungated elevation of 96 feet. At the top of the dam, the spillway can convey 305 cfs.

The watershed of Lyndon Institute Pond is relatively steep, mountainous terrain with half the land forest and the other half open land. Development in the watershed is limited mainly to Lyndon Institute located on the shore of the pond and Lyndon State College situated near the headwaters.

The surface area of the two ponds (3 acres at maximum pool), represents approximately 2% of the basin area.

5.2 Design Data

Data on the hydrologic design of Institute Pond Dam is not available.

5.3 Experience Data

There are no recorded experiences of overtopping but, a witness recalls that during the 1927 flood, the water level rose to within one foot of the top of the dam at the low spot on the left abutment. Also during the 1973 flood the road embankment (State Aid Highway #9) at Pond #2 was almost overtopped due to the discharge capacity of the 48-inch culvert. It should be noted that the dam failure in 1911 apparently was not due to flood flows.

5.4 Test Flood Analysis

Institute Pond Dam is 26 feet high and has a storage capacity of 44.6 acre-feet. In accordance with Article 2.1.1. of the "Recommended Guidelines for Safety Inspection of Dams", the dam is Small in Size based upon its height, which is greater than 25 feet and less than 40 feet. The hazard potential classification was determined to be High because failure of Institute Pond Dam is likely to endanger more than a few lives in a number of dwellings along the tributary and in the area of the culvert under State Route 122. In accordance with "Recommended Guidelines for Safety

SECTION 4 OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

- a. General. Institute Pond Dam creates an impoundment of water which is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert. Both ponds are controlled by Pond #1's concrete chute spillway which has a crest elevation of 96.0 feet. Pond #2 is further controlled by the 48-inch culvert with an invert elevation of 95.4 feet. The two ponds are used primarily for aesthetics. There is reportedly a drainage system for the dam, but has not been used in many years and it is not known whether the valve is operable.
- b. <u>Warning System</u>. There is no formal warning system to alert downstream residents in case of an emergency at the dam.

4.2 Maintenance Procedures

a. <u>General</u>. There is no set program for maintaining the dam. Neither the present owner, Mr. Mathewson, or the Lyndon Institute, who are jointly responsible for operation and maintenance of the dam according to the deed, have performed any maintenance in the recent past. This is evidenced by the growth of trees and brush on the dam and the fact that the drain has not been operated in many years.

4.3 Evaluation

There was no evidence that any maintenance had occurred for a period of years. The general operational and maintenance procedures can be described as poor to non-existent. There is a possibility of serious problems developing as implied from Section 3.2.

The owner should establish written procedures for operating and maintaining the structure. Also a formal downstream flood warning and surveillance plan should be adopted, including round-the-clock monitoring during heavy precipitation.

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in poor condition. The following features, if left unattended, could result in further deterioration of this dam.

Major seepage occurring at the downstream toe near the right end of the dam could result in a piping failure of the dam or instability of the downstream slope. Soft ground along the contact between the downstream slope and the left abutment is indicative of a seepage condition that might result in instability of the dam. Trees and brush which are growing on the crest, upstream slope and downstream slope of the dam may cause serious erosion and seepage problems if trees remain growing, fall over and pull out its roots, or if trees die and its roots rot. An animal burrow which was observed on the downstream slope of the dam could be a focus for seepage and piping which might result in breaching of the dam.

There is no erosion protection other than vegetation on the upstream slope and some evidence that erosion has occurred in the past near the waterline. If erosion is not controlled, it could lead to breaching of the dam.

The concrete-valve box structure near the downstream toe of the dam requires a more detailed inspection to assure that the piping system through the dam is not under pressure. If a pressure conduit condition exists this condition should be remedied. The downstream slope of the dam appears to have subsided or eroded on the downstream and right edges of the concrete-valve box structure, either of which phenomena could potentially endanger the stability of the downstream slope.

The large number of trees overhanging the chute spillway could potentially endanger the discharge capacity of the spillway if fallen trees or limbs accumulate in the spillway. A large tree growing adjacent to the chute spill ay could break the spillway if it falls over and pulls out its roots.

Erosion of the fill against a training wall at the downstream end of the concrete-chute spillway has taken place and could result in a failure of the training wall if the erosion is not controlled.

The concrete spillway efflorescence will probably result in eventual scaling of concrete surfaces. The erosion of concrete near the joints or the spillway chute could result in holes through the concrete spillway. The deterioration of the concrete near the drop sturcture might result in the collapse of a short section of concrete wall into the channel.

The presence of trees, brush, and coarse vegetation on the embankment and a pile of cut brush and small trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.

It is not evident whether the low elevation of the fill on the right and downstream edges is due to erosion, settlement, or the fill's having been placed that way at the time of construction.

There is a 4-inch cast iron pipe (Photo 21) discharging freely into the stream about 40 feet downstream of the drop structure of the spillway. The source of the water is unknown, but the pipe appears to be a part of the valve box and may be either part of the drain system or of the old water supply.

- d. Reservoir Area. The water impounded by the dam is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert (Photos 2 & 3, see Possible Flood Damage Map Appendix D). The water appears to be rather shallow in both ponds, as a result of sedimentation. The storage volume and surface area of the two ponds combined, at spillway crest elevation are 28.6 acre-feet and 2.6 acres, respectively and are divided almost equally between the ponds (see Appendix D, page 2 of 31). Trees are overhanging the right side of the pond next to the approach channel for the spillway at the right end of the dam.
- e. <u>Downstream Channel</u>. The downstream channel below the training wall of the drop structure is the natural streambed. The channel is significantly obstructed by fallen trees (Photo 22); however, due to its location (40 feet downstream of the dam) it poses no threat to the dam.

Water is discharging from the right bank of the downstream channel about 150 feet downstream of the downstream end of the spillway. It appears that this is a natural spring discharging groundwater from the side of the valley, and that it is not associated with seepage from the reservoir. There is a similar discharge, also believed to be unassociated with the reservoir on the left bank of the downstream channel about 175 feet downstream from the downstream end of the spillway.

The bottom of the natural valley on the left bank of downstream channel is covered with a few inches of gray silt in the vicinity of the skating rink which was constructed on fill higher up on the left side of the valley. This silt appears to be the result of erosion of the fill on which the skating rink was built, probably exacerbated by the large quantity of rainfall runoff from the roof of the skating rink. There were several erosion channels and sinkholes up to about 5 feet in diameter along the top edge of the fill between the skating rink and the valley bottom (Photos 23 and 24). There is no evidence to indicate that the erosion and sinkholes are associated with seepage from the pond.

The area immediately downstream of the toe near the right end of the dam was actively discharging seepage at an estimated rate of 10 to 15 gallons per minute at the time of the inspection. Standing water was also observed (Photo 7) between the toe of the dam and the downstream end of the concrete chute-spillway and drop structure, which carries the overflow about 40 feet downstream of the toe of the dam along the right side of the valley before discharging it into the natural stream channel. The seepage water was rusty but showed no evidence that it was carrying suspended soil particles.

Abutments. Both abutments of the dam appear to consist of soil. The left abutment consists of a ridge, the downstream side of which has been excavated for development of an indoor skating rink. The area between the skating rink building floor and the ridge is about 10 feet lower than the crest of the dam and is covered with sand and gravel. It showed no sign of seepage or wetness at the time of the inspection, but it is reported that some seepage occurred in that area when the excavation was made during construction of the skating rink and before the sand and gravel fill was placed.

c. <u>Appurtenant structures</u>. The concrete chute spillway located on the right side of the dam is completely concealed by overhanging trees. The concrete chute spillway (Photo 8) shows evidence of efflorescence in the training walls near the crest of the spillway (Photos 9 & 10). Water probably leaks through the training walls to cause the appearance.

The training walls and channel bottom erosion of the concrete chute spillway has occurred at many of the construction joints and shrinkage cracks (Photos 11, 12 & 13). Concrete erosion and deterioration has also occurred at the spillway drop structure (Photos 14 & 15) and at the base of the right side training wall downstream of the drop structure (Photo 16).

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On the left (downslope) edge of the concrete chute spillway there is a 4-foot diameter, hollow maple tree with a large animal burrow near its base (Photo 17). It is close enough to the chute spillway that it could damage the spillway if it falls over and pulls out its roots.

The downstream end of the concrete chute spillway (Photo 18) and of the concrete drop-structure consists of a concrete training wall which is approximately perpendicular to the right bank of the downstream channel. The fill on the downstream side of this training wall has been eroded 1-2 feet below the top of the wall and there are logs, brush, and debris in the eroded area (Photo 19). It appears that the erosion and the accumulation of logs brush, and debris may be the result of spillway discharge water flowing over the top of the training wall.

There is a concrete-valve box structure with a steel plate cover about 65 feet from the left training wall of the chute spillway and 5 feet above the downstream toe (Photo 20). The structure is about 5½ feet square in plan view. Along the downstream and left (right in Photo 20 which is looking upstream) edges of the structure, the embankment is within about 6-inches of the top of the structure.

SECTION 3 VISUAL INSPECTION

3.1 Findings

- a. <u>General</u>. The field inspection of Institute Pond Dam was performed on September 30, 1980. The weather was overcast. The inspection team included personnel from DuBois & King, Inc., Geotechnical Engineers, Inc., and Knight Consulting Engineers, Inc. A copy of the inspection checklist as completed during the field inspection is included as Appendix A. At the time of the inspection the water level was at the spillway crest (elevation 96 feet). Consequently, no assessment could be made of the upstream face of the structure below normal pool elevation.
- b. Dam. The dam is a 26-foot high earth embankment with a length of 250 feet and a 10 foot top width (Photo 1). The water impounded by the dam is divided into two ponds by a road embankment (State Aid Highway #9). The two ponds are connected by a 48-inch culvert (Photos 2 & 3).

<u>Crest of dam.</u> The crest of the dam is somewhat irregular but no evidence of slumping was observed. The crest of the dam is covered with grass, extensive brush, and small trees, most of which are less than about 4-inches in diameter (Photo 4). Near the right end of the crest there is a stump of a tree, about 12 inches in diameter, which was recently cut.

Upstream slope of dam. The upstream slope of the dam is about 1H:2.6V and is covered with grassy vegetation, brush, and small trees. There is a terrace-like feature on the upstream slope, about 3 to 4 feet wide and about 1/2 foot above the pond level at the time of the inspection (Photo 5). No evidence of active erosion on this terrace was observed.

Downstream slope of dam. The downstream slope of the dam is about 1H:2.6V and is covered with grassy vegetation, brush, and some trees up to about 4 inches in diameter (Photo 6). The growing brush and a pile of cut brush and trees on the downstream slope near the right end of the dam make it impossible to inspect the downstream slope adequately. There is one animal burrow on the downstream slope 10 feet from the left training wall of the chute spillway and halfway between the crest and toe of the dam. The lower part of the downstream slope in the central section of the dam is covered with waterborne vegetation, although the slope itself in that area was not wet or soft at the time of the inspection.

The contact between the downstream slope and the left abutment was soft and showed some evidence (small grass-covered channels) of past erosion but no evidence of active seepage at the time of the inspection.

SECTION 2 ENGINEERING DATA

2.1 Design

There is no design information available for either the original construction of the dam or its reconstruction following its failure in the year 1911.

2.2 Construction Data

All information is from photographs taken during the two construction periods before and after the failure in 1911.

2.3 Operation

No operating manual exists for Institute Pond Dam. The drain valve has not been operated in many years. The Vermont Department of Water Resources has on file records of past inspections performed by its personnel.

2.4 Evaluation

a. <u>Availability</u>. The available information is not sufficient for stability analyses of the dam or the appurtenant structures. The only background data which could be located consisted of construction photographs and inspection reports by the Department of Water Resources of the State of Vermont.

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- b. Adequacy. The lack of engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data. All assessments were based primarily on visual inspection, eye witness accounts of past performance, previous inspections, and sound hydrologic and structural engineering judgment.
- c. Validity. Not applicable.

i. Spillway

(1) Type

concrete chute spillway

(2) Length of weir

10-feet

(3) Crest Elevation

96.0

(4) Gate

None

(5) Upstream Channel

N/A

(6) Downstream Channel

natural river bed

j. Regulating Outlets

(1) Invert

Unknown

(2) Size (Conduit)

Unknown

(3) Description

Unknown

(4) Control Mechanism

Valve Box on downstream embankment

	(4)	Top of dam	41.3
	(5)	Test flood pool	43.6
f.	Reser	voir Surface (acres) (Ponds #1	and #2 combined)
	(1)	Normal pool	2.6
	(2)	Flood-control pool	N/A
	(3)	Spillway crest (ungated)	2.6
	(4)	Test flood pool	3.1
	(5)	Top of dam	3.0
g.	<u>Dam</u>		
	(1)	Туре	Earth Dam
	(2)	Length	250 feet
	(3)	Height	26 feet
	(4)	Top Width	10 feet
	(5)	Side Slopes Upstream Downstream	1:2.6 1:2.6
	(6)	Zoning	Unknown
	(7)	Impervious Core	Unknown. Photos of the 1911 pre-construction and 1911 breach of Institute Pond Dam all indicate that the dam had a concrete core wall at least part of its length.
	(8)	Cutoff	Unknown
	(9)	Grout curtain	Unknown

h. Diversion and Regulating Tunnel

Not applicable

5. <u>Total Project Discharge</u>

The total project discharge at the top of the dam is 305 cfs at elevation 100.5 feet. During the test flood, the inflow and the outflow are both 726 cfs at elevation 101.2 feet.

c. Elevation (feet)

	(1)	Streambed at toe of dam	74.5
	(2)	Bottom of cutoff	N/A
	(3)	Maximum tailwater	N/A
	(4)	Normal pool	96
	(5)	Full flood control pool	N/A
	(6)	Spillway crest (ungated)	96
	(7)	Design surcharge (Original Design)	Not know
	(8)	Top of dam	100.5
	(9)	Test flood design surcharge	101.2
	(10)	Top of State Aid Highway 9	102.3
d.	Reserv	voir Length (feet) (Ponds #1 and #2 combi	ned)
	(1)	Normal pool el. 96.0	650
	(2)	Flood control pool	N/A
	(3)	Spillway crest pool el. 96.0	650
	(4)	Top of dam el. 100.5	850

e. Storage (acre-feet) (Ponds #1 and #2 combined)

(5) Test flood pool el. 101.2

(1)	Normal pool		28.6
(2)	Flood control pool		N/A
(3)	Spillway crest pool	(ungated)	28.6

880

2. Maximum Known Flood. There are no available records, but according to a witness, the worst flood was in 1927. Reportedly the water level rose to within one foot of the top of dam at the lowest spot on the left abutment during the 1927 flood. Also during the 1973 flood the road embankment (State Aid Highway 9) at Pond #2 was almost overtopped, due to the limited discharge capacity of the 48-inch culvert, which replaced an arch bridge in 1968.

3. Spillway Capacity at Top of Dam

(a) Pond #1 - The principle spillway is a 10-foot wide rectangular chute. It is 106 feet long and has a 90° bend near the bottom of the chute. The end of the chute drops 11 feet vertically to the streambed. The capacity of the spillway at the top of the dam elevation of 100.5 is approximately 305 cfs. This represents the total discharge at the top of the dam.

A separate analysis was performed on the spillway chute. It was found that the chute will carry 305 cfs without overtopping the training walls as long as the chute is kept clear of debris. If the training walls are overtopped dangerous erosion may occur on the downstream slope of the dam. The water will flow over the wall at the 90° turn in the chute during normal high flows. This does not appear to create a hazard since the bend is below the toe of the dam.

(b) Pond #2 - There is no spillway for pond #2, but State Aid Highway 9 acts as a broad crested weir when the water surface elevation rises above the road elevation.

4. Spillway Capacity at Test Flood Elevation

- (a) Pond #1 The full PMF test flood for the 0.25 square miles is 726 cfs inflow. There is no reduction of the peak outflow due to the small amount of surcharge storage. Therefore, the peak outflow is also 726 cfs at an elevation of 101.2 feet; this represents an overtopping of the dam by 0.7 feet. The spillway will contribute 379 cfs (52%) of the total project discharge of 726 cfs.
- (b) Pond #2 The full PMF test flood for the 0.23 square miles is 692 cfs inflow. There is no reduction of the peak outflow due to the small amount of surcharge storage. Therefore, the peak outflow is also 692 at an elevation of 105.0 feet; this represents an overtopping of the road by 2.7 feet. Due to the topography of the site it is possible, for a portion of the discharge that flows over the road to bypass Pond #1. It will be assumed for purposes of this report that all of the outflows of pond #2 discharge directly into pond #1.

State Aid Highway 9 which divided the impounded water. In the same year, 1911, the dam was breached. Water reportedly reached the second floor of a house downstream of the dam. There was no loss of life or injury due to the breach. The dam was reconstructed some time after the dam failed. At one time the dam was used for water supply. The 4-inch pipe at the toe of the dam may be remnant of the distribution system. The valve box controls a drain for the dam, but may have also controlled the water supply system. The bridge on State Aid Highway 9 was replaced in 1968 by a 48-inch culvert.

Ownership of the dam was transferred from Mr. Vail to the Lyndon Institute and then to Mr. Mathewson.

i. Normal Operating Procedure. The valve box as previously noted is connected to a drain for the pond. It has not been used for a number of years and may be inoperable. The spillway maintains normal pool level and does not have flashboards or stop logs to control the water level. There is no operation procedure at the present time.

1.3 Pertinent Data

Ŋ

a. <u>Drainage Area.</u> The drainage basin of Institute Pond Dam has an area of 0.25 square miles. The terrain varies in elevation from 750 to 1140 feet and the land use is approximately one-half woodlands and one-half open land. Lyndon Institute is located on the eastern shore of the pond. Also Lyndon State College is located in the headwater of the watershed.

The reservoir area at the top of the dam is 3 acres and represents approximately 2% of the total drainage area. The predominate soils in the watershed are Woodstock - Colrain and Colrain - Woodstock Associations.

b. Discharge at the Dam Site.

1. Outlet Works

(a) Pond #1 - The spillway which controls the normal pool elevation is an ungated, concrete chute spillway. The weir is 4.5 feet below the top of the dam. The discharge at the top of the dam is 305 cfs.

There is also a valve box on the downstream toe of the dam. It reportedly regulates the drain pipe of the dam. The size of this pipe is unknown.

(b) Pond #2 - Pond #2's outflow discharges into Pond #1 through a 48-inch corrugated metal culvert. The invert elevation on the upstream end of the culvert is 95.4* or 0.6 feet below the spillway crest of the dam downstream. The discharge of the culvert at the top of road elevation is 108 cfs.

*NOTE: Elevations of the dam and appurtenant structures are based on an assumed datum with an elevation of 100 feet at the top of the left training wall of the spillway.

and the size of the pipe or pipes it controls is unknown. There is also a 4-inch cast iron pipe discharging freely into the stream below the dam (Photo 20). The source of this water is not known.

- c. Size Classification. Institute Pond Dam is 26 feet high and has a storage capacity of 44.6 acre-feet. In accordance with Article 2.1.1. of the Recommended Guidelines for Safety Inspection of Dams, the dam is Small in size based upon its height, which is greater than 25 feet and less than 40 feet.
- d. <u>Hazard Classification</u>. The dam has a hazard classification of High. Development downstream of Institute Pond Dam which would be affected is concentrated near State Route 122 where the tributary passes under the road. This development includes 3 to 4 dwellings, a plumbing and heating supply store, elementary school and a playground located close enough to the stream to receive damage. There is also an ice hockey arena located immediately downstream of the dam (Photos 8, 21).

The flood wave generated by a breach of the Institute Pond Dam would be approximately 11 feet high in the vicinity of the ice hockey arena. Some damage may occur to the ice hockey arena, depending on breach location.

The wave would be approximately 14.4 feet high when it reaches the State Route 122 culvert or 3.9 feet above the road. The resultant flood wave would cause appreciable damage to State Route 122 and 3 to 4 structures in the area adjacent to the culvert with flood levels up to 4 feet above the first floor of these dwellings. It is probable that other housing units located in the fringe areas of the valley would suffer lesser damage from the resultant flood. The playground by the elementary school which is fequently used by children would be completely inundated. Downstream of State Route 122 is uninhabited therefore no damage will occur in that area. The energy of the flood wave would be greatly dissipated when it reaches the Passumpsic River 0.4 miles downstream of the dam. It is possible that more than a few lives may be lost if the dam is breached.

- e. Ownership. The dam is owned by Philip Mathewson, Lyndon Center, Vermont 05850; telephone (802) 626-5193. During the winter months his address is Casa del Ray Mobile Court, 5249 Fifth Street Circle West, Bradenton, Florida 33507.
- f. Operator. According to the deed for the dam, operation and maintenance is the responsibility of both Mr. Mathewson and Lyndon Institute.
- g. <u>Purpose</u>. The dam is used only for aesthetic purposes. At one time it was reportedly used for water supply.
- h. <u>Design and Construction History</u>. Based on construction photographs and information given by Mr. Mathewson, the dam was built by Mr. Vail in the year 1911. Photographs taken during the construction of the dam seem to indicate a partial concrete core wall. There was originally a bridge on

NATIONAL DAM INSPECTION PROGRAM PHASE I INSPECTION REPORT LYNDON INSTITUTE POND DAM

SECTION 1 PROJECT INFORMATION

1.1 General

a. <u>Authority</u>. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. DuBois & King, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to DuBois & King, Inc., under a letter of September 11, 1980, from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACQ33-80-C-0003 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

- (1) to perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.
- (2) To encourage and prepare the states to quickly initiate effective dam safety programs for non-federal dams.
 - (3) To update, verify and complete the National Inventory of Dams.

1.2 <u>Description of Project</u>

- a. Location. Institute Pond Dam is located in the Town of Lyndon, Caledonia County, Vermont. The dam is located on a tributary of the Passumpsic River, approximately 0.4 miles upstream of the confluence. The dam is shown on the 15 minute U.S.G.S. quadrangle for Lyndonville, Vermont, with coordinates approximately 72° 1.1' west longitude, 44° 32.2' north latitude. The location of Institute Pond Dam is shown on the Location Map immediately preceeding this page.
- b. Description of Dam and Appurtenances. Institute Pond Dam is an earth embankment approximately 250 feet long and 26 feet high. The impounded water is separated by State Aid Highway 9 into two connected ponds. Pond #1 is downstream of Pond #2. The principal spillway which controls the normal water level is a concrete chute spillway. There is a concrete valve box located near the downstream toe of the dam. It has not been used recently

Inspection of Dams," the test flood is the full Probable Maximum Flood (PMF). The HEC-1 computer program (Hydrologic Engineering Center-Flood Hydrograph Package) was utilized to calculate the PMF discharge and route the PMF inflow hydrograph through the structure. The PMF test flood for Pond #2 (drainage area = 0.23 square miles) is 692 cfs. Due to the small amount of surcharge storage in Pond #2 no reduction to the inflow hydrograph occurred during the routing process through the 48 inch culvert. The test inflow was routed through Pond #2 assuming the water surface to be initially at elevation 96.0 feet (normal pool). During the test flood, the road embankment (State Aid Highway #9) will be overtopped by 2.7 feet (elevation 105.0). Due to the topography of the site it is possible, for a portion of the discharge that overtops the road to bypass Pond #1. It will be assumed for the purposes of this report that all of the outflow of Pond #2 discharges directly into Pond The 48-inch culvert can pass 108 cfs at the top of the road embankment (State Aid Highway #9) (elevation 102.3) or 16 percent of the routed test flood outflow. The 12 PMF flood of 346 cfs would have an outflow of 346 cfs, which overtops the road embankment (State Aid Highway #9) by 2.0 feet (elevation 104.3). The PMF test flood for Pond #1 was calculated by combining the inflow hydrograph at Pond #1 and the outflow hydrograph from Pond #2. The PMF test flood for Pond #1 is 726 cfs. Due to the small amount of surcharge storage in Pond #1 no reduction to the inflow hydrograph occurred during the routing process through the 10-foot concrete chute spillway. The test inflow was routed through Pond #1 assuming the water surface to be initially at elevation 96.0 feet (normal pool). During the test flood, the earth dam will be overtopped by 0.7 feet (elevation 101.12). The 10-foot concrete chute spillway can pass 305 cfs at the top of dam (elevation 100.5) or 42 percent of the routed test flood outflow. The $\frac{1}{2}$ PMF flood for Pond #1 of 363 cfs would have an outflow of 363 cfs, which overtops the dam by 0.1 feet (elevation 100.6).

5.5 Dam Failure Analysis

Utilizing the Corps' April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs," a dam failure analysis was performed for Institute Pond Dam. Prior to failure, it was assumed, the water level was at the crest of the dam (100.5 feet), the chute spillway was discharging 305 cfs and the storage volume behind the dam was equal to the combined storage of the two ponds at elevation 100.5 (41.3 acre-feet). A breach width of 100 feet (40% of length of the dam) and breach height of 26 feet were used in the Saint-Venant equation to compute an instantaneous discharge of 22,290 cfs. The total discharge would be the instantaneous discharge plus the chute spillway discharge just prior to break or 22,595 cfs. The breach outflow would produce a 11.3 foot flood wave immediately downstream of the dam in the vicinity of the ice hockey rink. The hockey rink is approximately 15 feet above the streambed. The water stage above the streambed prior to the dam failure just downstream of the dam would be 1.1 feet. Approximately 1,450 feet downstream of the dam the outlet channel passes under State Route 122, through a concrete culvert. This constriction in the outlet channel increases the height of this flood wave to 14.4 feet which overtops the road by 3.9

feet. This is expected to flood approximately 5 to 6 dwellings, located in the proximity of the State Route 122 (See Possible Flood Damage Area Map in Appendix D), producing water levels about four feet above first floor level and inundate an elementary school playground frequently occupied by children. The stage prior to the dam failure at the State Route 122 concrete culvert would be 7.4 feet. The hockey rink may also be subject to severe flood damage if the dam break were to occur on the left abutment end of the embankment which is located immediately above the rink.

No development exists approximately 100 feet downstream of State Route 122; therefore, no structural damage will occur below this area. See appendix D, for the Possible Flood Damage Area Map.

The lives of more than a few persons would be endangered in the vicinity of State Route 122, therefore, the dam is classified as High hazard.

SECTION 6 EVALUATIONS OF STRUCTURAL STABILITY

6.1 Visual Observations

Based on visual observations there are several features of this dam that present potential structural problems.

Seepage appears to be the major potential structural problem. As mentioned in Section 3.1 there was an active discharging seepage area at the time of inspection, at the toe of the dam. There was also a wet zone in the contact area between the downstream face and the left abutment, indicating a seepage condition.

Another potential structural problem which can lead to additional seepage problems is the flora growth on the dam. As can be seen from the aerial photograph and the individual photographs (Photos 4, 5, 6, 7 & 17) the plant and tree growth does appear to be a potential problem. Seepage and erosion problems can develop along the root systems of trees and structural disturbances may occur due to trees being blown over.

The concrete erosion and deterioration of the chute spillway appears to be a potential structural problem. Concrete deterioration can lead to piping problems through this dam and also to structural collapse of sections of the chute spillway, which in turn could cause a dam failure.

Other areas of possible potential structural problems are:

- 1) The lack of erosion protection on the upstream slope;
- 2) The possibility of subsidence or erosion along the concretegate box structure on the downstream slope;
- The possibility a pressure conduit condition may exist through the dam; and
- 4) Rodent burrows on the downstream slope of the dam.

The presence of trees, brush, and coarse vegetation on the embankment and a pile of cut brush and trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.

6.2 <u>Design and Construction Data</u>

There is no design or construction data available except for construction photographs. (Construction photographs are the property of the owner, Philip Mathewson)

6.3 Post-Construction Changes

There are no post-construction changes to the dam recorded. However, the bridge on State Aid Highway 9 was replaced by a 48 inch culvert in 1968.

6.4 Seismic Stability

This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

SECTION 7 ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

D

- a. <u>Condition</u>. The visual examination indicates that Institute Pond Dam is in poor condition. The major concerns with respect to the integrity of the dam are:
 - (1) Major seepage at the downstream toe of the dam, which could lead to a piping failure of the dam or to instability of the downstream slope and the area immediately downstream of the toe of the dam.
 - (2) Trees and brush growing on the embankment could lead to seepage and erosion problems if a tree falls over and pulls out its roots or if a tree dies or is cut and its roots rot.
 - (3) A wet zone along the contact between the downstream face and the left abutment indicates a seepage condition that might result in instability of the dam.
 - (4) Subsidence or erosion of the downstream-slope fill along two edges of the concrete-valve box on the downstream slope may be indicative of a condition that could adversely effect the stability of the slope.
 - (5) Lack of erosion protection on the upstream slope could result in severe erosion and breaching of the dam.
 - (6) A large tree growing adjacent to the chute spillway could break the spillway if it falls over and pulls out its roots.
 - (7) Erosion of the fill against a training wall at the downstream end of the chute spillway could result in failure of the wall and the spillway.
 - (8) Concrete deterioration could result in holes through the spillway bottom or collapse of sections of spillway wall.
 - (9) The drainage system has not been operated in many years and may be inoperable. The conduit size is also unknown. This system may be under pressure, due to the impounded water, which could result in a piping failure of the structure.
 - (10) Rodent burrows on the downstream slope of the dam could lead to piping failure of the dam.

- b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection. The presence of trees, brush, and other coarse vegetation on the dam embankment and a pile of cut brush and trees on the right end of the downstream slope make it impossible to inspect the embankment adequately.
- c. <u>Urgency</u>. The owner should implement the recommendations in 7.2 and 7.3 within one year after receipt of this Phase I report.

7.2 Recommendations

The following investigations and needed corrections should be performed under the direction of a registered engineer qualified in the design and construction of dams.

- (1) Specify and oversee procedures for the removal of trees and their root systems from the embankment, a zone 25 feet wide at the downstream toe of the dam, and on each side of the concrete-chute spillway.
- (2) Investigate the seepage near the downstream toe of the dam and the soft wet area along the contact between the downstream slope and left abutment, and design remedial measures.
- (3) Investigate the cause of the subsidence or erosion of the downstream slope adjacent to the concrete-valve box structure and design remedial measures. Also investigate the concrete valve box structure for a possible pressure conduit condition that may exist through the dam. If a pressure conduit condition exists upstream control should be provided.
- (4) Design erosion protection for the upstream face of the dam.
- (5) Investigate the concrete in the spillway and downstream retaining wall. Design repairs and/or replacement of concrete sections as necessary.
- (6) Perform a detailed hydrologic hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase project discharge capacity.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should implement a systematic maintenance program consisting of the following items:

- (1) Cut and remove brush on the dam embankment.
- (2) Visually inspect the dam and appurtenant structures once a month.
- (3) A technical inspection program should be initiated and continued on a yearly basis.
- (4) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency.
- (5) Establish a procedure for rodent control.

7.4 Alternatives

Removing Institute Pond Dam and draining the upper pond (Pond #2) by lowering the culvert, may be considered as an alternative to the recommendations of Section 7.2 and 7.3.

APPENDIX A VISUAL CHECKLIST WITH COMMENTS

VISUAL INSPECTION CHECKLIST PARTY ORGANIZATION

PROJECT <u>Institute Pond Dam, VT</u>	DATE <u>Sept. 30. 1980</u>
	TIME 0930
	WEATHER <u>Overcast</u>
	W.S. ELEVU.SDN.S
PARTY:	
1. Robert Wernecke, D & K	6
2. <u>Charles J. Kissel, D & K</u>	7
3Stephen Knight, KCE	8
4. Ronald Hirschfeld, GEI	9
5	10
PROJECT FEATURE	INSPECTED BY REMARKS
1. <u>Farth Dam</u>	R. Hirschfeld
2. <u>Concrete & Appurtenances</u>	S. Knight
3. <u>Hydrology/Hydraulics</u>	R. Wernecke & C. Kissel
4	
5	
	
10	

NOTE: All elevations used in this report are assumed based on an elevation of 100 feet at the top of the left training wall on the top of the dam.

PROJECT Institute Pond Dam, VT	DATE Sept. 30, 1980
PROJECT FEATURE	NAMERobert Wernecke
DISCIPLINE	NAMEStephan Knight
	NAMERonald Hirschfeld
AREA EVALUATED	CONDITIONS -
DAM EMBANKMENT	•
Crest Elevation	100.5
Current Pool Elevation	96.0
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	Crest elevation is slightly irregular
Lateral Movement	None observed
Vertical Alignment	Slightly irregular
Horizontal Alignment	Slightly irregular
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Minimal
Sloughing or Erosion of Slopes or Abutments	Small terrace 3-4-ft-wide and ½-ft above pond level on upstream slope, apparently due to wave erosion. Now covered with vegetation. Apparent erosion of embankment on right side of gate structure on downstream slope
Rock Slope Protection - Riprap Failures	No riprap

PROJECT <u>Institute Pond Dam. VT</u>	DATE <u>Sept. 30, 1980</u>	
PROJECT FEATURE	NAMERobert Wernecke	
DISCIPLINE	NAMEStephan_Knight	
	NAMERonald_Hirschfeld	
AREA EVALUATED	CONDITIONS	
DAM EMBANKMENT-continued		
Unusual Movement or Cracking at or Near Toe	None observed	
Unusual Embankment or Downstream Seepage	Major seepage at downstream toe of right half of dam. Left contact of downstream slope and abutment is soft and shows some signs of erosion but no active seepage.	
Piping or Boils	None observed	
Foundation Draniage Features	None observed	
Toe Drains	None observed	
Instrumentation System	None	
Vegetation	Trees, up to 12-inch - dia. and some grass vegetation on upstream slope, and downstream slope. One 12-in.dia. stump crest.	

PROJECT Institute Pond Dam, VT	DATE Sept. 30, 1980
PROJECT FEATURE	NAME_ Robert Wernecke
DISCIPLINE	NAME Stephan Knight
	NAME_ Ronald Hirschfeld
AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	No Dike
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failure	es
Unusual Movement or Cracking at or Near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	

::

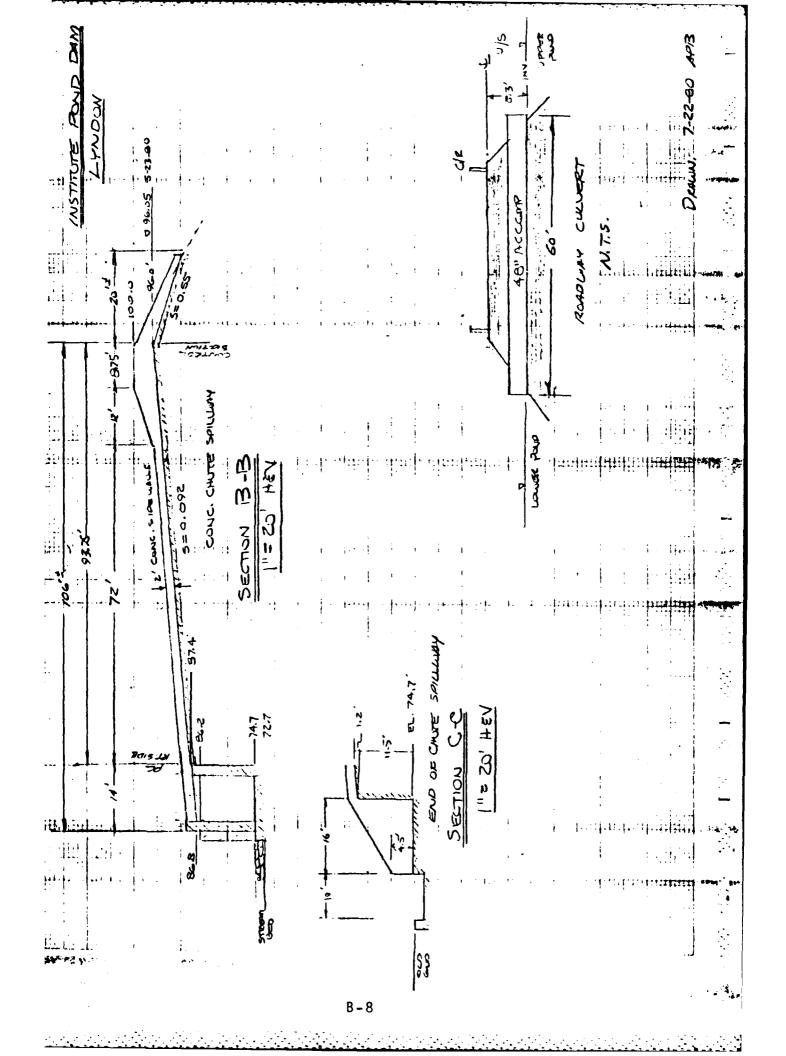
PROJECT Institute Pond Dam, VT	DATE Sept. 30, 1980
PROJECT FEATURE	NAME Robert Wernecke
DISCIPLINE	NAME Stephan Knight
	NAME Ronald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Intake not visible beneath pond surface.
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	, ! !
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

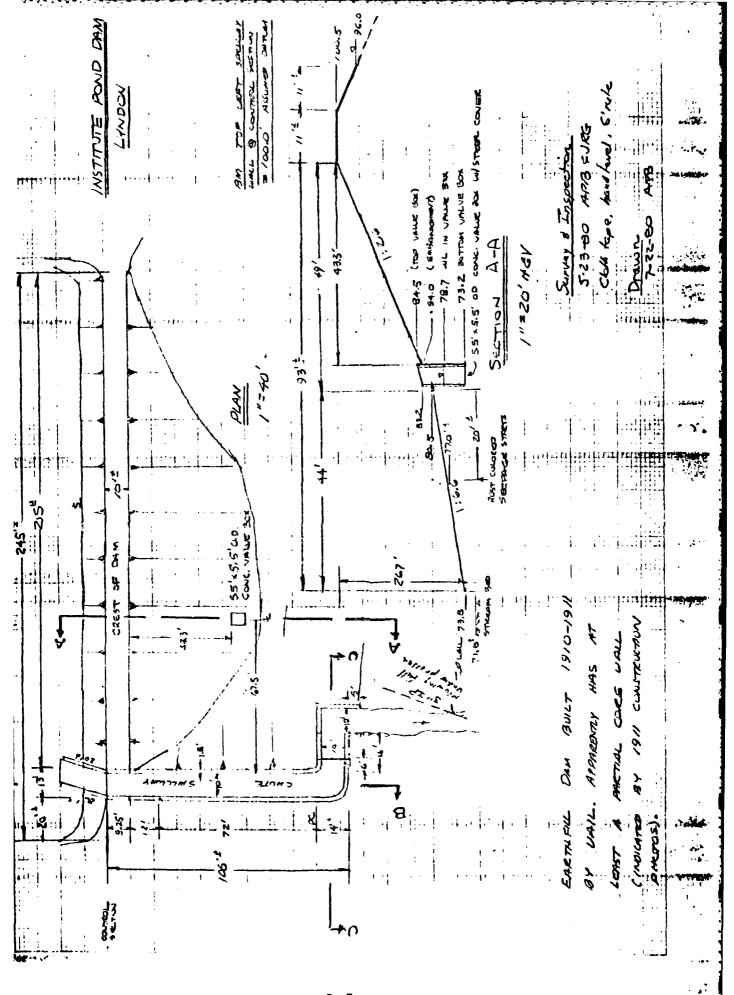
PROJECT Institute Pond Dam, VT	DATE Sept. 30, 1980
PROJECT FEATURE	NAMERobert Wernecke
DISCIPLINE	NAMEStephan Knight
	NAMERonald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	No Tower - See Outlet Structure
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Service Gates	

State of Vermont Agency of Environmental Conservation Department of Water Resources Montpelier, VT 05602

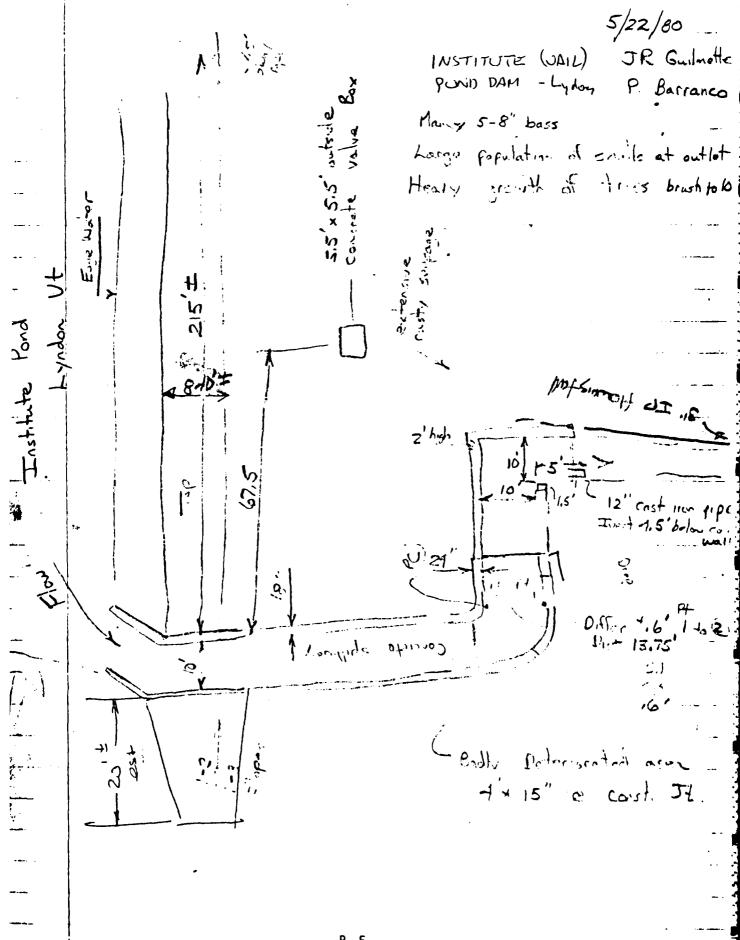
DAM INSPECTION REPORT

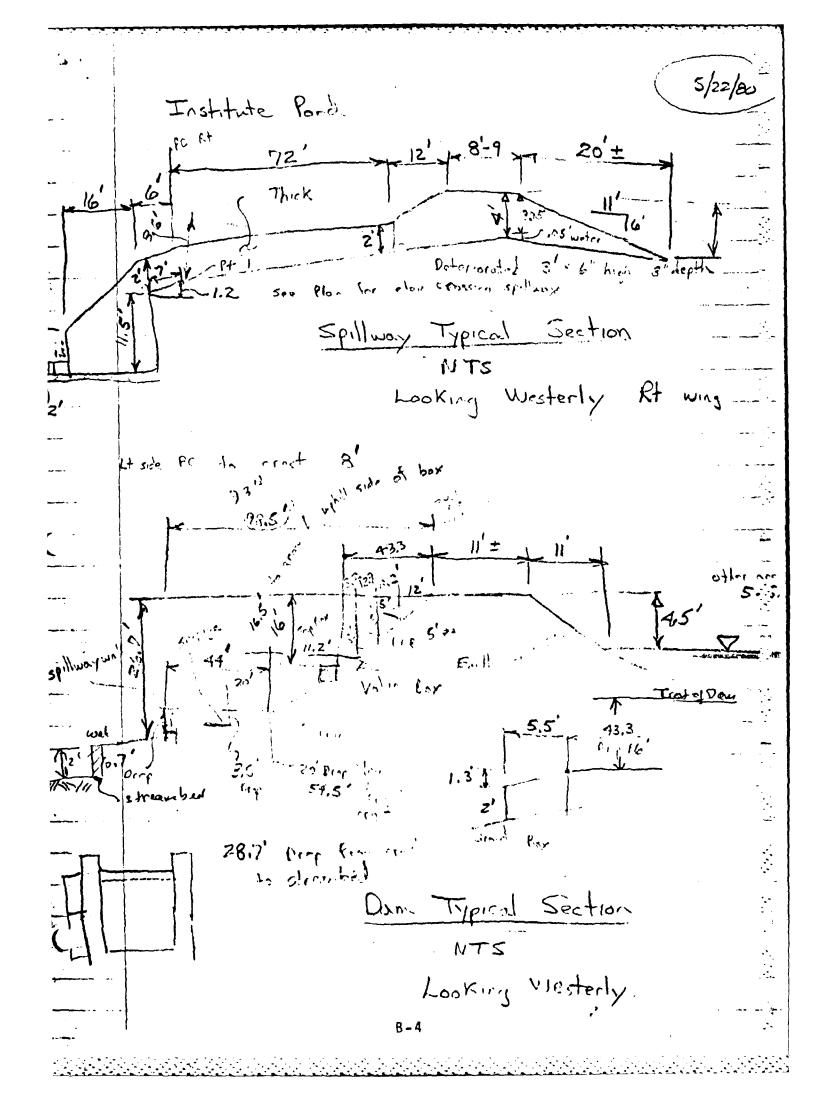
INSTITUTE POND	DWR No	//9~/
LYNDON		
Philip Mathewson	Inspection Dat	te <u>5-23-80</u>
ess Lyndon Center, Vt.	Last Inspecte	ed 10-30-75
phone 626-5793	· Hazard Clas	ss2
	Size Categor	cy
ONS PRESENT AT INSPECTION (Na	me and Organization	١.
	_	
ecting Party A.P. Barranco,	•	
J. R. Guilmette	e - Facilities E	निर्वाणेटकानेव
rs		
Weather Hazy, 80° Water Surface Elevation 7 Accessibility Fully accession Aifficult because of brusheservoir Area	Ground Condit 60.05' ble but waspector	Datum crest of spillwoin of embackness
Remarks <u>AIKJA VAIL R</u> w.	D	•
•		





Lyndon Valve Box Typ to Know if Mr Mollerson mount 1.1 A Vienn 1110 101 1.1.1 ke stand 7/24180 plet with Hr. Blothewson. Recommended Heat His VIVO TOP & not be desc. because of possible blavour of freedation. due to extend 1 serging + possibly quill ordology. Advoced needed a well designed filter drawage system. Out Rosdway





4. When the down breached in 1911, water was at
the second floor level in a house downstream but no
loss of life or 14 juny ocurred.
_5. Water has seeped into the basement of one of the
Torstotake buildings on the 12ft side of the pund above
_ the road. This apparently in a fill area. Mr. Mutheusens
scernises it might be from de pond.
· ·
Other notes: remarks by the writer:
_1. The old photographs show the original bridge where _
The 484 ACCEMP now is. This bridge appeared to provide.
a signable waterway connecting the upper and lower portions
_ of the pond. A facture of the dawn with the old
bridge would have been more serious because the
entere pend would dixing repidly. The road and 49
culvet in effect form a dam which would greatly
restrict dreat the repidity of drowdown of the upper ponds
dom would for all practical purposes in involve , release
don would for all practical purposes in troobse a release
of the lower pand.
2. Downstonen conditions were not checked boyond the
survey to needed. It does not appear that the
The ice arom would be seriously affected by a
failure of the dove.
A CONTRACTOR OF THE CONTRACTOR

_10: File Frum! APB _ Subj. | Firstitute (Vail) Point Dam - Lyndon

On May 23e the writer and John quilmette inspected subject dam. The dam is judged to be in poor condition because of the seapage at the foe possibly quick conditions downstream of the toe and the heavy cover of trees and brul on crest and both stop. (Jee Inspection report).

Dimensions and photographi were obtain.

The writer and John Guilvielle met the owner, Mr. Mathewson, who provided information on the history of the down. M: Mathewson shared us several photographs of the dain during - As construction in June and July 1911. The photographs show details of construction of the chote spillulay and the unbankiness. _It oppers that a partial concrete core well is incorporated in The design attacept, no evidence of it can visible during the inspection. Mr. Matienson said the dam washedout Cappounts during or stortly after compruetion and the breach area was - repaired by a steel plate. One of the photographs apparently _ shows the broach (near the spilleray where there appears ______ to be a gap in the core wall). Often historica notes provided by Mr. Malieuser.

_ 1. The down was built by Mr. Vail.

- 2. The Mathewson's aguined the claim from Lyndon Furtitude. The dead makes the owner and Lyndon - Fishtute jointly responsible for its monteners, 1927 was a flooked at a low spot at the left abutment.

APPENDIX B

ENGINEERING DATA

Description

Subsurface Soils Information

4.

Location

None Available

None Available Lyndon Institute Pond Design Records 1. Past Inspection Records 2. Appendix B, pages 82-821 A. Two inspections in the year 1980 Vermont Department of B. Others Water Resources State Office Building Montpelier, Vermont 05602 **Plans** 3. None Available A. Original plans Figure B-1, pg. B-22 B. General Plans Figure B-2, pg. B-23

APPENDIX B
ENGINEERING DATA

PROJECT Institute Pond Dam, VT	DATE Sept. 30, 1980
PROJECT FEATURE	NAME Robert Wernecke
DISCIPLINE	NAMEStephan Knight
	NAMERonald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	No Bridge
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

PROJECT Institute Pond Dam, VT	DATE <u>Sept. 30, 1980</u>
PROJECT FEATURE	NAME Robert Wernecke
DISCIPLINE	NAME Stephan Knight
	NAME Ronald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees overhang channel
Floor of Approach Channel	Appears to be soil
 Weir, Training Walls and Concrete Chute Spillway 	
General Condition of Concrete	Fair
Rust or Staining	Some staining
Spalling	Eroded & spalled concrete at joints & cracks
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Efflorescence at dam & at drop structure
Drain Holes	None observed
Trees Overhanging Channel	Many trees overhang chute
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Many trees overhang channel
Floor of Channel	Sand and gravel
Other Obstructions	Many logs in channel, especially below right-angle bend in channel

PROJECT Institute Pond Dam, VT	DATESept. 30, 1980
PROJECT FEATURE	NAMERobert Wernecke
DISCIPLINE	NAME Stephan Knight
	NAMERonald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	5½' x 5½' Box in good condition
Rust or Staining	Moderate staining & moss growth
Spalling	None
Erosion or Cavitation	Moderate erosion of soil to right of concrete box
Visible Reinforcing	None -
Any Seepage or Efflorescence	None visible
Condition at Joints	Good
Drain holes	None
Channel	
Loose Rock or Trees Overhanging Channel	Trees overhang discharge channel
Condition of Discharge Channel	Poor; many logs in channel and tre- overhanging channel.

PROJECT Institute Pond Cam, VT	DATE September 30, 1980
PROJECT FEATURE	NAME Robert Wernecke
DISCIPLINE	NAME Stephan Knight
	NAME Ronald Hirschfeld
AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	Not Visible
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

A. Ups	cream Face or Slope
. 1.	Vegetative Cover Deuse growth of brush and trees
2.	Erosion Not savere.
3.	Slumps, Slides, Cracks none observed but stop
4.	Animal Burrows none observal
5.	Slope Protection <u>Mouc</u>
6.	Debris
7.	Structural 1/a
8.	Abutments low area at left abutment; righ
9.	Alignment to much brush to tell
10.	Movement none apparent
11.	Remarks @ enspection limited by brush and traces
	6 poor condition

Down	stream Face or Slope and Toe
1,	Vegetative Cover heavy growth brush and trees lyp tok
	- wet type vegetation ordine stope
2.	Erosion not significant
. 3.	Slumps, Slides, Cracks none cisorved - stope irregular
4.	Animal Burrows None observed
5.	Slope Protection none
6.	Debris nouse
7.	O Slopes damp but no semple observed @ The below value box he seepage substantil seepage and stredits water (rust aboved). Most seepage enters als channel below that spillway - estimate flows 1-3 quality soups located along left street bent 201 disto and of the
8.	Piping none observed but difficult to tell at the (see they).
9.	Boils Area below value bux may be quick.
10.	Toe Drains noue observed
11.	Scour some at and of traving well below theyte
12.	Structural valve lex is only structual iten
13.	Abutments for aver at faft abutment, right abutment
	not checked

:	14.	Alignment difficult to tell because of brush and forces
	15.	Movement none apparent
	16.	Remarks O serious concern about segrage at fore
		condition
<u>c.</u>	Cres	
	1.	Vegetative Cover dance brush and frees
	2.	Erosion none significant
	3.	Evidence of Overtopping Mode
	4.	Settlement, Cracks none observed - crest is irregular
	5.	Animal Burrows none deserved
	6.	Debris Mcvic
	7.	Use of crest (road, trail, etc.) foot peth
·	8.	Structural no structual items
	9.	Abutments /ces area at left abutment, right abutme
		not checkel

<u>r</u>		10.	Alignment court tell because of brush and trees
		11.	Remarks poor condition
			1
<u>III.</u>			of Outlet Works
	<u>A.</u>		cipal Spillway
			Broad exerted triangular wein with chute
		,	rolled or Uncontrolled <u>ancontrolled</u> - no provision
			•
		1.	Approach Channel clear
		2.	Transition clear - sither somewhat
		3.	Control Section small angust debn's - congrete good
		4.	Discharge Channel (Chuft) Side walls perficul. Some delegional of concrete walls 20' disto control section + delevioration of correcta
		5•	Side wells between overfall and als training walls feely determined and order Intake Structure
		6.	Conduit 12" of CIP (111 V. 45" before for right training could) visible for 51. Aliquined does not 70 to lake box. Could frace price but posselly possibly and drain
		7.	Outlet Structure see Nos. 1-4
		8.	Trash Racks
		9.	Anti-vortex Devices //a

,	
11.	Remarks Except for part below 11.5 overfall are deteriorated sections in flow and sidewalls, spills is in fair shape for its age.
	defenished sections in flow and sidewalls, spills
	is in fair shape for its age.
Emer	rgency Spillway
Туре	Nune
Cont	crolled or Uncontrolled
1.	Approach Channel
2.	Transition
3.	Control Section
4.	Discharge Channel
5.	Remarks
•	
Dra	wdown Facilities, Gates, Drains, Appurtenances, Etc.
1.	Drawdown Facility A 5.5x5.5 x 10' deep concrete velve
	bux will, I hade for value located on all slope in
	Condition for Size of pipe (5) un Revoun Possite
	12" & CIP moted is contluse on Het council. The ne
	12" 4 CIP noted in spilling outlet court. The outlet now the had never
	opened value. Value box was filled to 6.51 with a

Stop Logs, Flash Boards not provided for

10.

120

		full) enters the outlet stream about 40 d/s/o and
	,	chite. Aliquered of exposed pipe ques towards value condition But in partially blocked extra by a crean
		and the partiety between entry a commen
		or delins. Owner dee not know where it coines
	3.	Remarks Olunes has nove used pond draines
	•	it is not known of it is operate.
		•
. Ope	ration	and Maintenance
	lo op	watered procustives. No mantenance has been
		for some time. The owner found it difficult to Ke
,		-leaving the brush. Now the brush and trees form a
us 1	المانيا	cleaning Fix Dhuth NOW The bhill and Trees toke a
•		·
•		·
Scree	en to	block the view of the new ice arena from
Scree Ocus Ins	er to spection	black the view of the new ice arena from
Scree	er to spection	block the view of the new ice arena from
Scree Ocus Ins	er to spection	black the view of the new ice arena from
Scree Ocus Ins	info	black the view of the new ico arena forms on Summary or Summary ormation Obtained
Scree Ocus Ins	info	block the view of the new ice arena from on Summary ermation Obtained Photographs
Screen Ins	Info 1. 2.	block the view of the new ico arena for on Summary ormation Obtained Photographs Dimensions Other
Ins A. B.	Info 1. 2. Add:	block the view of the new ico arena for on Summary ormation Obtained Photographs Dimensions Other itional Information Needed
Ins A.	Info 1. 2. Add:	block the view of the new ico arena for on Summary on Summary Ormation Obtained Photographs Dimensions Other itional Information Needed As channel further dixin. Re-examine seums
Ins A.	Info 1. 2. Add:	block the view of the new ico arena for on Summary on Summary Ormation Obtained Photographs Dimensions Other itional Information Needed As channel further dixin. Re-examine seums
Ins A. B.	Info 1. 2. Add:	black the view of the new ice arena four were, on Summary promation Obtained Photographs Dimensions Other itional Information Needed As Chausel further dexus. Decreased seminar seminare
Ins A. B.	Info 1. 2. Add: Check Re-w	block the view of the new ice arena from ormation Obtained Photographs Dimensions Other itional Information Needed As Chausel further dixus. Re-example season Kamerica conser's photos & Check right and of day and
Ins A. B.	Info 1. 2. Add: Check Re-w	black the view of the new ice arena from four on Summary Dimensions Other Itional Information Needed As Chausel further dixus. December Seure Kanner courses photos & Check right and of dear and Tall Condition of Dam
Ins A. B.	Info 1. 2. Add: Check Re-w	block the view of the new ice arena from ormation Obtained Photographs Dimensions Other itional Information Needed As Chausel further dixus. Re-example season Kamerica conser's photos & Check right and of day and
Ins A. B.	Info 1. 2. Add: Check Re-w	black the view of the new ice arena from four on Summary Dimensions Other Itional Information Needed As Chausel further dixus. December Seure Kanner courses photos & Check right and of dear and Tall Condition of Dam
Ins A. B.	Info 1. 2. Add: Check Re-w	black the view of the new ice arena from four on Summary Dimensions Other Itional Information Needed As Chausel further dixus. December Seure Kanner courses photos & Check right and of dear and Tall Condition of Dam

- <u>VI.</u>	General Comments		
·	Suppose at the and o	documestream is	ol senius
· ·	sources. Possible prick and	Utions present.	0
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in.			
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	Opm. 1	•	
" Rep	port By Chely Beresseep.	Date	5-23-80
	A Peter Barranco, Jr. PE		
	Van Safety Regineer -DUR		
	achments:		
0	Photos		
(Z)	DINANSIONS		
3	Motogramshic may of reservoir	area	
3	Marro re: in exerting and com	porcelina with m	in na. 11

i File

in: APB

ulj: Institute Rad Dam - Lyndon

On 7-22-80 the writer investigated downstream channel conditions below the Institute Pend Pen. The outlet stream from the pond crosses under TH ris an G.S.X.8' concrete culvert about 1500' below the dam. One 11/2 Stry. frame house on the U/s sike of the culvert has its first floor only 8' above stream bad and water up to the 2th floor when the dam failed in 1911, however, due to reduction in pond volume subject to quick release during a failure now, flood stages should be much less). Two other buildurgs (resultance) might be subjected to some damage. SEE SKETCH

Stopped by the Mathewson's howe and gook with Her.

O) Discussed seepage at too of dan. Recommended against dispose diagned for diain seepage as this might disturb delicate belonce if area is quick and load to facture of foundation by piping. Advised that a half designed drawage / filter system was needed.

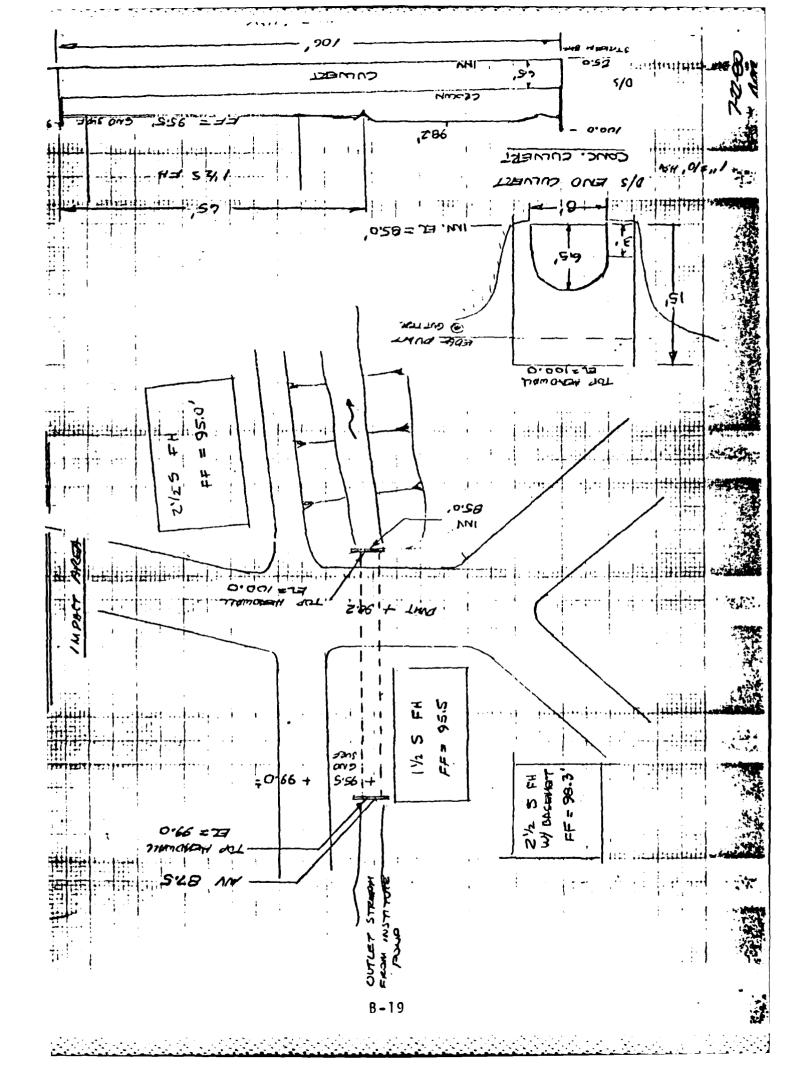
(2) My princy concerns with law work brush and there great and secongs problem.

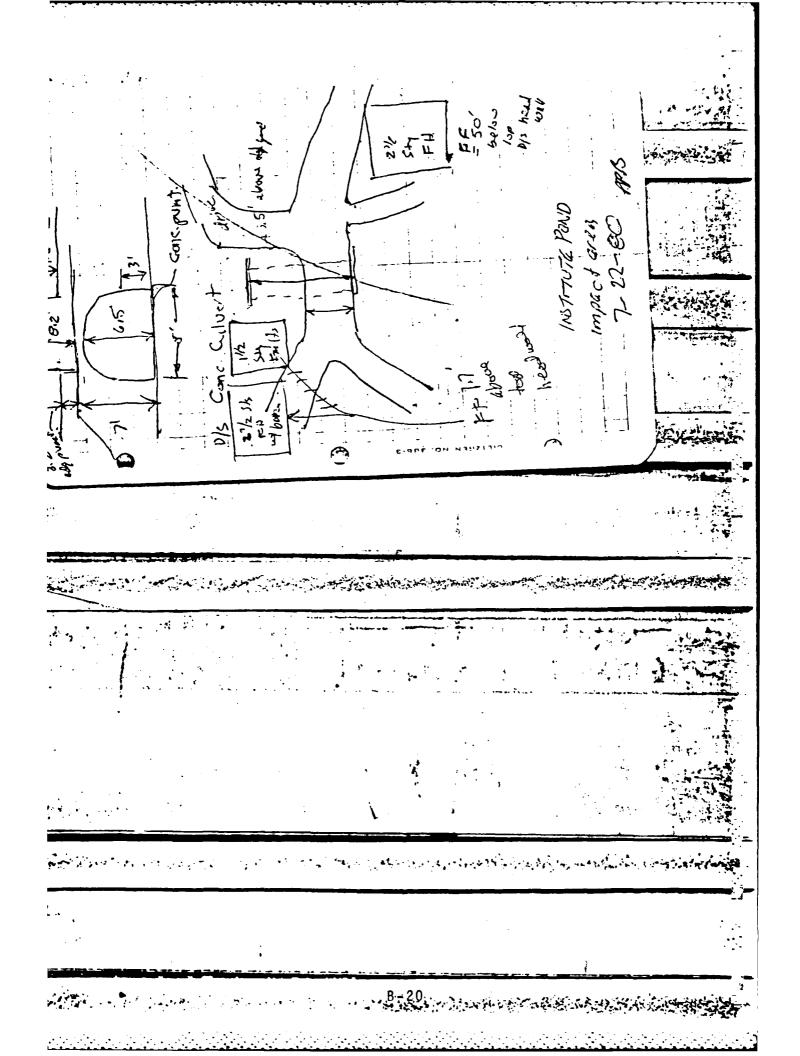
(3) Advised den my again be insputed. (B, Cops unda Phose I).

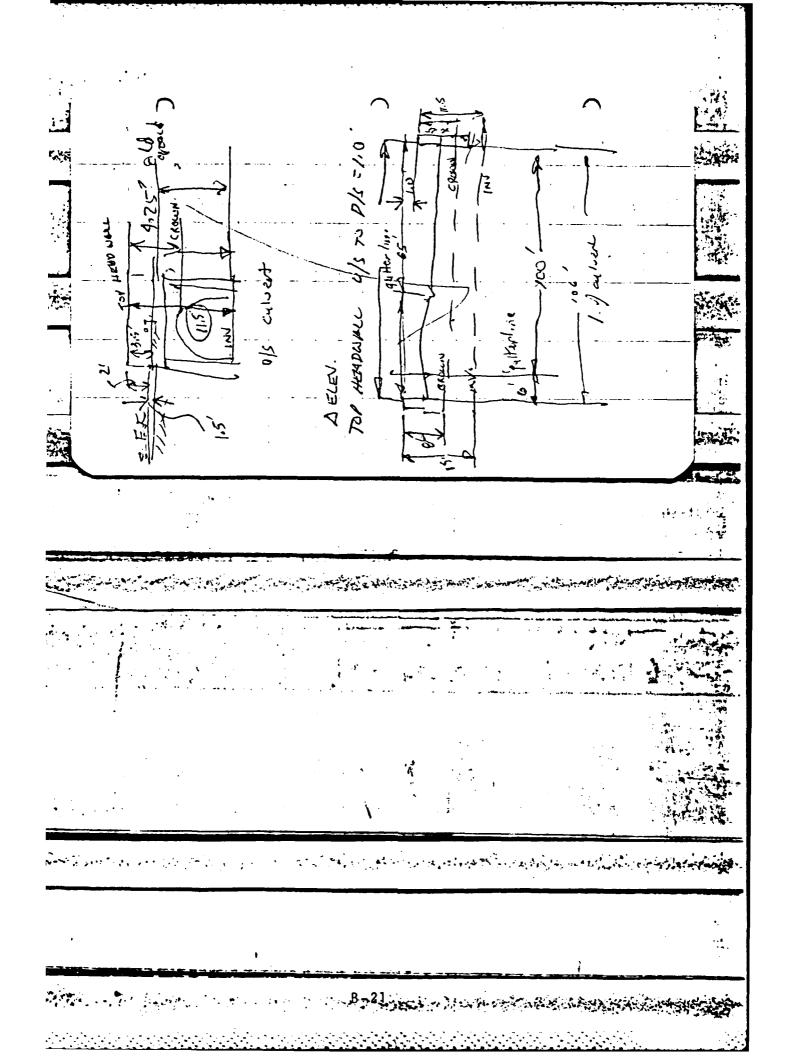
6) Mr. Mathewson said that during high fixes water had gone

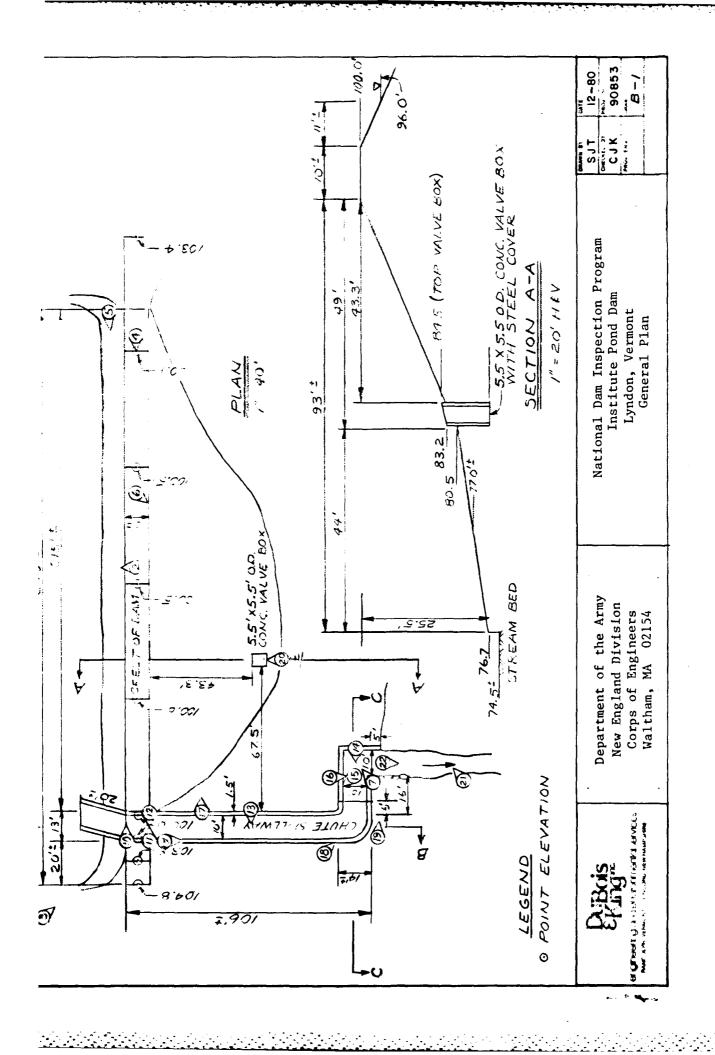
around right end of gadway wal. He has tried to fell this area with brush and other nuterial. Did not look at this area to day but should be checked out.

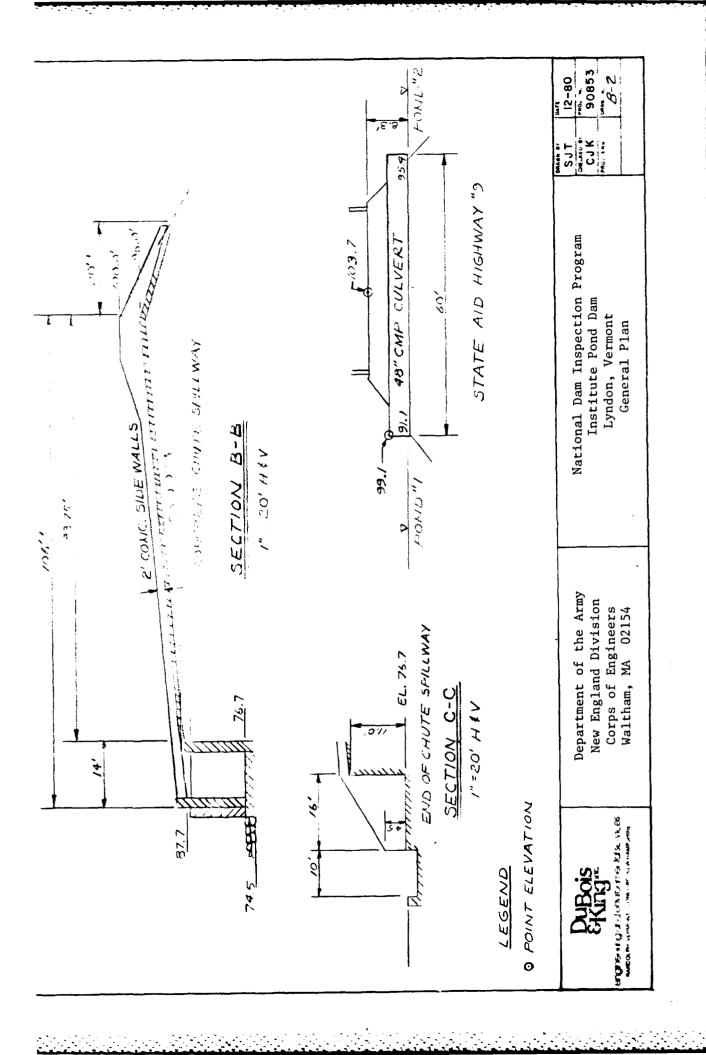
- (3) Mr. Makewson said the said below the add ground on the left side of the dam would act like jath when they were excavating for the ico areas. Also boils appeared in the parking that left and drive before they covered it with gravel.
- m Lynder Fistitude records.
- (7) According to Mr. Matheusen, the deed for the day has a provision that the Institute is partially responsible for uptup of the dem.
- (8) An Makeuson will try to get copies of the Construction photos (1911) made for the Dest.











APPENDIX D
HYDROLOGIC & HYDRAULIC CALCULATIONS

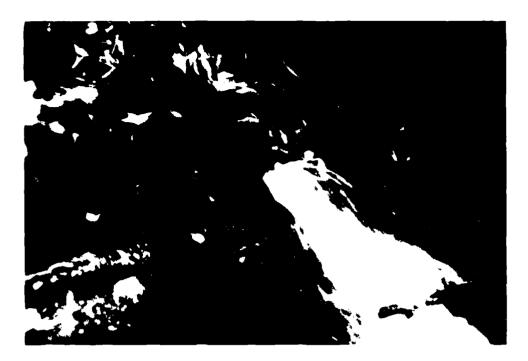


#23 - Ice hockey arena downstream of dam, (photo location on Possible Flood Damage Area Map ~ Appendix D)



#24 - Sink holes near Ice hockey arena (photo location on Possible Flood Damage Area Map - Appendix D)

. 9



#21 - Discharge from 4 inch pipe about 40 feet downstream of drop structure



#22 - View of Downstream Channel



#19 - Logs and brush downstream side of drop structure



#20 - Concrete-box-gate structure with steel plate cover near downstream toe of dam



#17 - 4-foot-diameter hollow maple tree about 10 feet left of chute spillway



#18 - Downstream end of chute spillway before drop structure



#15 - Left wall at spillway drop structure
 (Notice concrete erosion)



- 1

244

#16 - Right training wall downstream of drop structure (notice concrete erosion)



#13 - Right wall of chute spillway (notice shrinkage crack and bottom erosion



#14 - Drop structure at end of chute spillway (notice concrete erosion







#9 - Looking downstream at chute spillway



#10 - Left wall of chute spillway at crest of dam (notice efflorescence)



#7 - Major seepage area at downstream toe



#8 - Looking downstream at crest of concrete chute spillway



D

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E

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#5 - Upstream slope of dam looking toward right abutment



#6 - Downstream slope of dam looking right



#3 - Road Embankment, State Aid Highway #9, upstream side of road (notice 48 inch culvert)(Photo location on Possible Flood Damage Area Map - Appendix D)



*

#4 - Crest of dam looking toward right abutment



#1 - Crest of Dam, from State Aid Highway #9(notice 48 inch culvert, discharge end, lower left corner) (photo location on Possible Flood Damage Area Map-Appendix D)



APPENDIX C

PHOTOGRAPHS

FOR LOCATIONS OF PHOTOS, SEE FIGURES B-1 AND POSSIBLE FLOOD DAMAGE AREA MAP LOCATED IN APPENDIX B AND D

Dubois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 90853	Sheet _/_ of _ 3/
Project _ Twenty to Pour Dan	Date 10/15/80
Subject Dinivone Aug.	By :225 Ch'k, by

From U.S. G.S. Lyndonville, Vt. scale 1: 62500

Planimeter Readings

0.25 0.51 0.255

0.255 in2 (0.973) = 0.25 mi2

Ave. Reading = 0.255 in2

Drainage Area = 0.25 mi2

Job No. 90853	Sheet z of <u>3/</u>
Project Institute Peno Den	Date 10-27-80
Subject Hackure - Austrice	By 🖾 Ch'k. by

STINGE-HREN DITH - STHEE - STORME DIT	
- \```` \` \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	771
SIMOL PIKEN DITTH - SIMOL STOKINGE PAT	

•	INST.	TOTE KILD	ı	رح ۔	PRAGE	
ELEVATION	PONO #1	POND#2		POILOT	POINS #2	TOTAL
(2)	(KREZ)	(MRES)		AC-IT	AC-FT	STURMOE
SPICEWAY CREST=96:D	1.2	1.40		0	0	C
Torca Duci	1.40	1.6		5.9	6.8	12.7
101.5				7,3	8.4	15.7
102.5				8.7	10.0	18.7
102.5		I		10.1	11.6	21,7

- D'HEEN CONFORMIUNE THEEN FROM ARING PHOTO DETHINED PROM THE VERNO TO DEST. OF MENNINYS DIVED 1/11417, 1975. VENENT LINE + PAUTE NO. 23-1618
- @ About Committees preco in THERD SURVEYS
- @ Pan #2 MEN MERINEED AT THE SING PATE ME POND !

THE HELDITION WILL BE THAT BOTH PONDS THE HEET DEEP. STORINGE BELOW STILLING CREST IS THEN SO TO BE THE FOLLOWING!

POND #/	Paris "Z	TOTIL.	ELEVATION
AC-FT	AC-FT	AC-FT	(FT)
13,2	15.4	28,6	96.0
:			

46 1320

KOP 10 X 10 TO 12 INCH 7 X 10 INCHES KEUFFEL & ESSER CO MADE IN USA .

Job No. Project Zn-+++ Pond Subject Pond	Date	
Subject Discharge Parting Constitution Parting Cons	(2) <u>Elev. 100. S'</u> Z 1 S'	?i≤Ch'k. by

Wien Section #	Length	Elev.	Coeff. *
\mathcal{D}	10'	96	3. 2
⊘	215'	100.5	2.5
3	5	101'	2.5
\mathscr{C}	<i>3</i> 5	102'	2.5
آق ا	5	/03 [^]	2.5
\mathfrak{C}°	10'	104.z'	2.5

The above information is a simplification of the actual dam profile taking into account effective flow over the crest of the dam.

* Coefficient was taken from the "Hundbook of Hydraclies" by Brater & King.

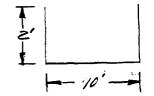
Job No Projec Subjec	:t //	V571	TUTE	e fo	210 - H	Z)n (·							Date	et <u>s</u> of 20-27 212 Ch'k.	7-80	`
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Mere 5 Were 6									8	88	161.	142	200					
Vene S							4	B	23	γ M	49	59	140					
Wene 2			! !			06/	538	787	1520	2125	2793	3519	6933					
Ecumon Were 1 Nene 2		35	6	99/	305	358	4/3	470_	530	593	657	724	2101					
Cessma	96	76	98	66	lois	101.0	101.5	201	1025	103	123.5	104.0	106.0			ř		

DuBois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060-

loh No	Coa!	Sheet 6 of 3/
	INSTITUTE POUS DIM	Date <u>//-6-80</u>
•	HYLLHICIC - HYDROLOCY	By Ch'k. by

THE IMPLIENT DISCHMEGE THAT THE SPILLWAY FOR INSTRUME POND DAN (AT POND*1) IS 305 CFS. HA MANYETS FOR THE SPILLWAY CHOTE IS NECESSARY TO CHECK IF THE MAXIMUM DISCHARGE IN THE SPILLWAY CHUTE WILL GET OF BANK.

Current Spiling Curte slore · 0.078 m= 0.015



$$Q = \frac{1.47}{0.016} \cdot 10(d) \left(\frac{10(d)}{10+2d} \right) \left(\frac{0.078}{10+2d} \right)^{\frac{1}{2}}$$

$$30C = 27.74 \cdot 10(d) \left(\frac{10(d)}{10+2d} \right)^{\frac{1}{2}}$$

d	Q	729
0.5	16.	1.2
1.6	246	9.4
1.5	458	14.5
2.0	704	19.2
		l

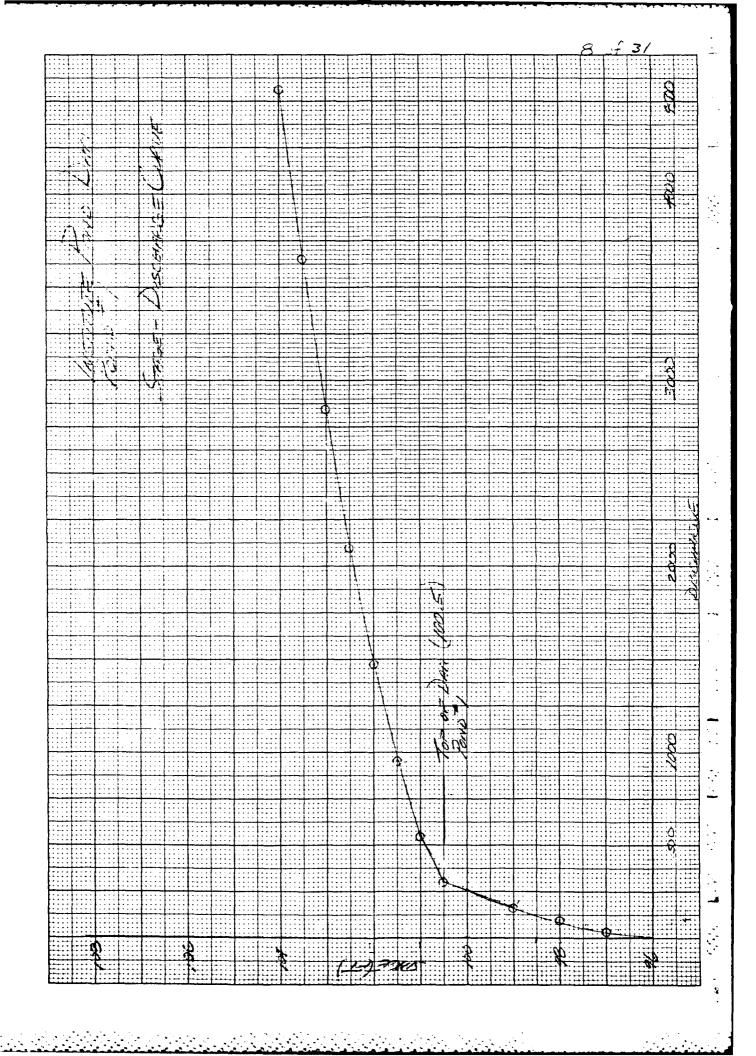
THE SPICLULAY CHOTE HAS THE CHPACITY TO CONTAIN THE STANDARD OF THE SPICLULAY, 305CFS, THE DEPTH IN THE SPICLULAY CHOTE WILL BE MAPPECY INTAITEDY EQUAL TO 1,2 FEET. THIS IS 0.8 FEET BELOW TOP OF CHOTE. THE SPICLULAY CHOTE NUT RESIDENCE FOR THE WATER TO GET OUT OF BANK AND TRAILED POWN THE POWNSTROWN FACE AF THE MAIN THIS IS DUE TO THE MICH VERGITES IN THE SALCHARY CHOTE.

uBoi & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 10855	Sheet _7_ of _3/
Project Justinie Pens Pour	Date 11-6-80
Subject Musikus - Hypicical	By

MINICESS OF CHUTE SPICLARY (CONT)

AT THE DOWNSTEND END OF THE CHUTE SPILLWAY,
WHERE THE CHUTE SPILLWAY THREE A 90° BEND, THE
DISCHMEGE WILL GET OUT OF BANK, HENEVER THIS WILL
NOT APPECT THE DOWNSTREAM FACE OF THE DAM, BECAUSE
THE CHUTE SPILLWAY DISCHMEGES APPECLANTELY 20 FRET
DOWNSTREAM OF THE TOE OF DAM.



S & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 20853	Sheet <u>9</u> of <u>3/</u>
Project Insurant Poiso	Date 12-27-80
Subject Hosenic - Hyprice Y	By ACh'k. by

PENDEZ

WOR FLOW OVER ROOD

Q=CLH⁴²

Q=25tas 1/2 H²⁵

Q-257-9/2H²⁵
Q,
Q,
Q₂ Q₃ Q₄ Q₅ Q₆

102.3

102.3

102.3

103.7

104.7 104.7 105.0

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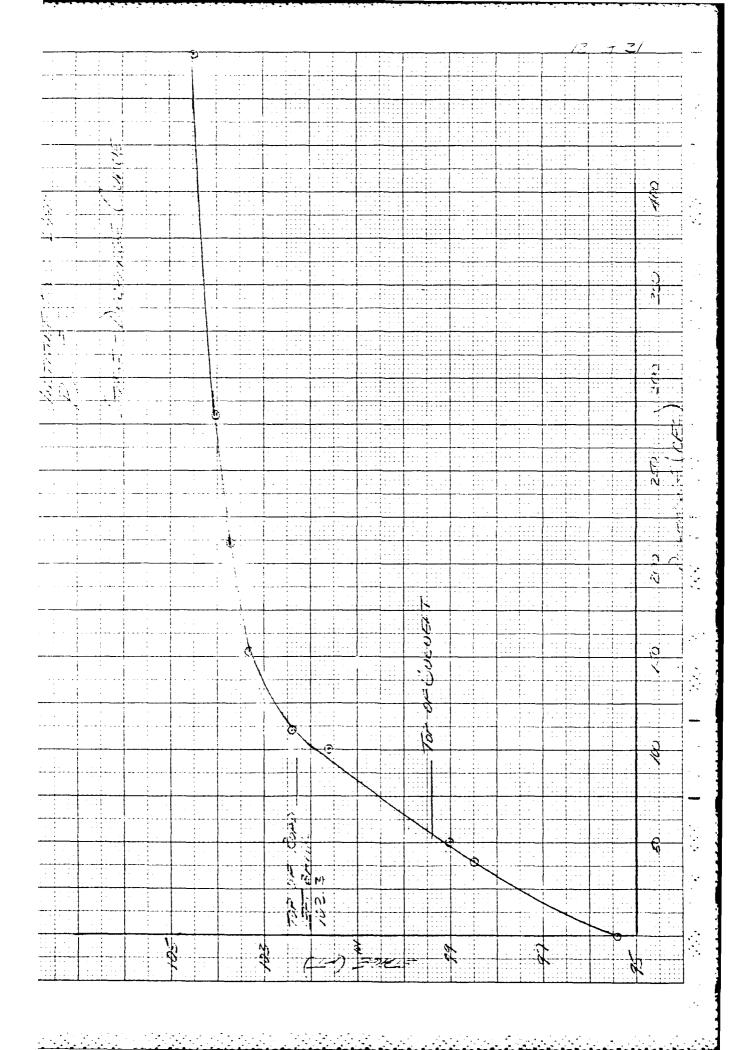
106.7

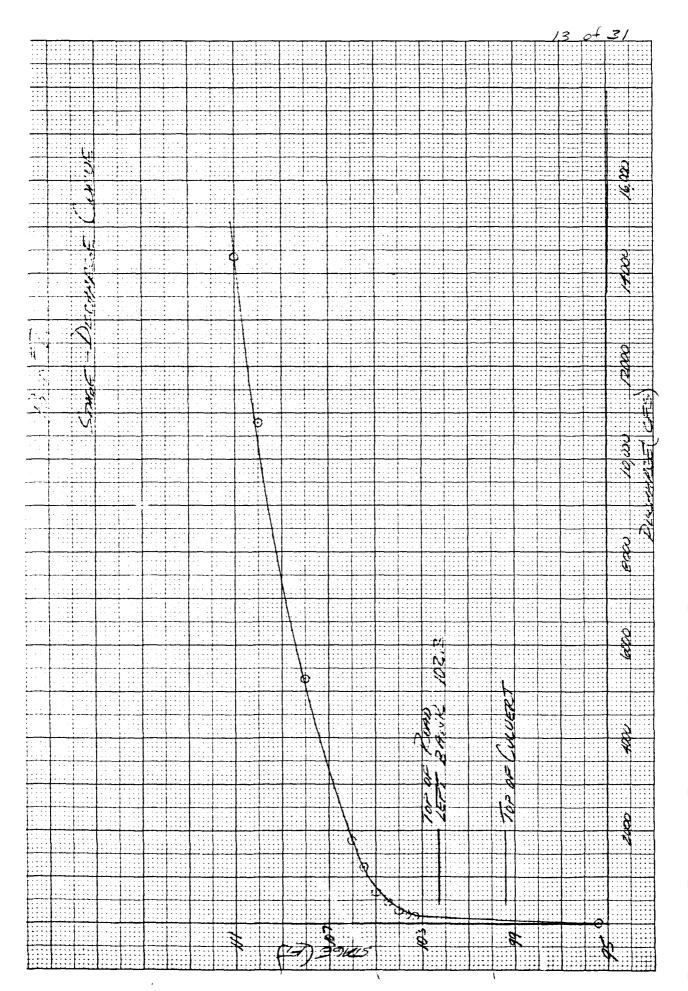
SEE FOLLOWING PAGE FOR CONPUTATIONS

	10. 105S		Sheet 10 of 3/
Subje	ct <u>Institute Pous De Doni</u> ect <u>Hudemuses - Huden co</u> r	1 POND#Z	Date <u>10-27-20</u> By CTLCh'k. by
1,0,m (c/s)	1945 1027 1030 1030 1030 1040 1040		
(S)	8.50 8.50 8.55 8.55 8.55 8.55 8.55 8.55		
(85)	300 300 29-0 29-0		
4 (See 5)	12 2 8 2 2 4 2 8 8 8 8 8 8 8 8 8 8 8 8 8	;	
5 (8)	12 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 CH "5" 5(20) H'5"	12 13 14 15 14 15 14 15 14 15 14 15 14 15 14 15 14 15 14 15 14 15 16 16 16 16 16 16 16 16 16 16 16 16 16
£ (\$	24 / 25 / 26 / 24 / 25 / 25 / 25 / 25 / 25 / 25 / 25	Q = C LH 2 = 2.5(20)h 6, = 50H"5	Q=50,1,5 Q=50,1,5 Q=50,1,5 Q=50,1,5 Q=50,1,5
F (8)	46/24/25/25/25/25/25/25/25/25/25/25/25/25/25/	176.8 15.5	≫ 4 .
Junes (A)	103.7 104.0 104.0 105.0 106.0 110.0	15/8/8	COET- BY 50% S NOT SAME 1- 44.8 H 2.5
			V-word is clessed of -

DATE: 10-55-81	CHANNEL INFORMATION STATION: COLOGENT. EL.	AHW=	=	129 NEAN STREAM VELOCITY = MAX, STREAM VELOCITY =		OUTLET CONTROL HW=H+ho-LSo	AEF On.	2.1 25 146 19 29 1.2 29 30 51 31	3.3 000 620 3.13 6.4 3.12 03 3.6 3.6 3.6 99.0	53 30 35 2. 5. 03 62 6.2	07 137 21 20 33 30 03 70 70		ENDATIONS:
) }	TW, =	TW2 = 10 of a Dischange, say 029 of 02 = CHECK DISCHANGE, SAY 050 OR 0	8	INLET CONT.	HW O	257	1.63 3.3	1.46 5.3	100 60		FIONS:		
	AND CHA	1	1	SIGN DISCHANG ECK DISCHANG	_	OSIZE		18 C+	50	100	011		I ≶ \
PROJECT:	HYDROLOGIC AND CHANNEL INFO	" 0		30 = ² 0)	CUIVERT	DESCRIPTION	(ENTRANCE TYPE)	6.11.5					SUMMARY & RECOM

NOTE: CONSUMMENTANS THESI FLOW HOWSHAWE CHINES 102 TO.

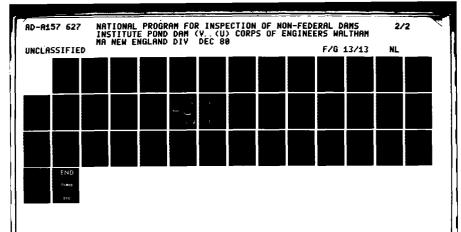


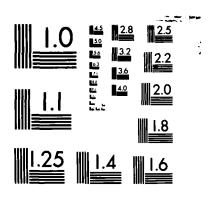


19, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

90853	Sheet <u>14</u> of _3	
HEC-1 DATH	Date <u>/0-20-</u> By ©K Ch'k. by	
unce theen = 0.25m²	and Source Despre	
DATES DATH THEON FROM DESIGN DATES THEON FROM GONDENC SOILS COUNTY, VT (NON 1974)		(
STOCK - COGENIN		
MM - WOOD = POCK	,	
N-GHOLD C	•	
OCK - SON GROUP NOT LISTED, ACCUMED	GROUP C	
ente 18 DH Alcesembe 50% FALTURE		
mos (psz) men 3 mens or thros		
FIG. H-Z(a) HC=2 FIG. A-Z(b) CN: 72 (HIX-II)	50% 72 50% 79	36.5 38.5
E(p. 536) - FAIR CONDITION		·
CN=79 (ACC-II)	CN = 76 FCR INSTITUTE WHITE	TE PONS TREMED
WITTING HASTRACTION) = 1.63 " N. (2	542)	ı
NT LOSS RATE = 0.12 MAL (p.64)		,
Deran en Since Dons (p. 48+	49)	
= 19.5 (6mm) (10m2)		
-100		
-11/		
/3.0	A	

4





MICROCOPY RESOLUTION TEST CHART
NATIONAL BURFALL OF STANDARDS-1963-A

DuBois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. <u>20853</u>				Sheet 15 of 3/	
Project Institute Food	ــــــــــــــــــــــــــــــــــــــ			Date 10-20-80	
Subject <u>//ec-/ Data</u>				By CTZCh'k. by	
SINDER METHOD					
ty = G(LLCA)0.3	tg=la	iz tu			
	L= Le Ups	NGTH OF TRESTO LI	Main War 1917 of L	ERCOURSE TO KAININGE AKUN "	. * • * *
	LCA = Los OPA Den	COTH ALONG CSITE THE VININGE BA	· PHIN WINE - CENTROID CIN = 0.66	ECOVESE TO PE OF THE OILES	OINT
				CIENT = 2.0 PES	
	Cp = sm	icer's Per Feari Chou April	ARING COO U'S HANDEO ICD HYDRO	FFICIENT = 0.6 DON OF LOGY	3
DIM MIRON FROM	U.S.GS	MARE (scme 1.	·62500)	
SUB- PREA FOR I DEMINING ALON	POND#Z				
L= 1.09 mies Len= 0.57 mies		met,). France	<u>"VGTH</u> 1.TY 3	
= C+ (Lla) = 2.0(1.09)(0.57)	1.2 to		= \frac{\siz^2}{2} \sigma = 0.8 \frac{7}{2} = 1.25		
tp = 1.7 MRS.		16	,		
SUB-AREA ADR.		DV TEX	evane(ts)=	264 FT	
L: 0.05 MES	-		e <i>unre</i> (t _p) = t _p	0.5 The = 0.15 pres	
Len: 0.025 mis	70,3		·		
tp = 2.0 (0.05)(0.025)	= 0.27 Hz	ر خ	PAVE = 0	· CI MIC	

Job No. 90953	Sheet 16 of 3/
Project Lycrost Paris Dans	Date 10-30-80
Subject HIDERENCE - HYDRICE OCY	By 224 Ch'k. by

Summey OF BASIC DATE

INSTITUTE POND DING.
THE DANS IS COCHTED IN THE TOWN OF LYNDON, VEXITATE

CLUSSIFICHTION

SIZE - SAMLE (BUSED UPON IMPOUNDMENT HEIGHT)

HIRARD - HIGH BUSED ON 30R 4 RESIDENTIAL STUCTURES HAND SCHOOL RUILDING IN THE DOWNCTREAM AREA

Paro 1

MORIAL PECK ELECTRICAN - 96.0 PT STIRAGE - 13.7 MC-FT

MANNON POOL ELEVATION - 100,5 FT STORME - 19,4 AC-FT

POND Z

Noume Pack ELEVATION - 96.0 PT STORINGE - 15.4 M-PT

MAJIMUM PACE ELEMTICA - 102.3 FT STORAGE - 25.2 K-FT

Dubois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 20832	Sheet
Project Lucrea TC PC & Dell's	. Date <u>10-30-80</u>
Subject Hoseours - Historics	. By ÆCh'k. by

SUMMEY OF ENSIC DATH

DAM - FOR POND* THE DAM IS ENETH FILL

FOR POND* THE ROAD EMBANKMENT ACTS

AS A DAM

OUNET - FOR POND "1- A CHUTE SPILLWAY IS USED

AS AN OUTLET.

POND = Z - A 48" CMP CULVERT IS USED AS AN

OUTLET

INSTITUTE POND IS IN SERVER OF THE POND, THE PONDS

NES SEPONDATED BY IN BOAD ETIENTIRITENT. THE THE PONDS

ALE CONTRECTED BY IN 48 INCH CITY CULULAT UNDER THE

ROME DIBMIRMONT. INSTITUTE POND DIAM IS ECCHTED

OF THE POND ROWSTROWN OF 48" CULULART

Job No. 90853	Sheet <u>/8</u> of <u>3/</u>
Project LASTITUTE PEND DIN	Date 10-30-80
Subject Hymnourcs - Hymnocogy	By \(\tau \times Ch'k. by

HEC- I WHE USED TO CHECULITE THE DESIGN FROOD FOR INSTITUTE PEND DAM.

CLASSIFICATION

Size - since Unaneo- High

Deren Francis

HIDROCOGIC EURIUNTION GUIDELINES RECONNENDS THE DESIGN FECCE RE ENTIRE & PITE OF FULL PITE,

SEE THECE I FOR SUTTINEY OF HEL-1 CONFUTER RUNS.

CONTLUSIONS

POND * 1 + POND ? STERME CHPHEKITIES, DO NOT REDUCE THE DICHMEGE PEARS FOR ETTHER THE FILL PITE OR THE 1/2 PITE.

THE SPICLOMY FOR POND" | CAN ONLY PASS 305CFS BEFORE
THE DAY OVERTOPS. THE 48"CMP LUCERT FOR POINT CAN ONLY
PASS 108CFS BEFORE THEOLD EVENIMENT OVERTOPS.

THE PITE DESIGN FLOOD WILL RESULT IN THE DWIT FOR POND* !

RESING CLERTOPPED BY DIT FEET. PEND "Z ROND GIRNNEMENT

WILL BE OLERTOPPED BY ZIT FEET FOR THE PITE.

ECHE OVERTOUPED BY D. I HEET. POND "Z ROAD ETTENDENT WILL BE OVERTOUPED BY Z.O FEET FOR THE ZPIT.

Job No. 90855	Sheet <u>/9</u> of <u>3/</u>
Project INSTITUTE POUD DON	Date 10-30-80
Subject Hiserry 162 - Hypracoc 1	By \(\overline{I} \(Ch'k. by

THELE # 1

4	larans #	Carpor (Carpor)	2.101	100.6
(200	June 20	9.2.2	298
, lk	Consined	(يعن)	226	363
# 378K/	BNO=1	Dumine (CP)	76	47
<i>[</i>	1500 # 3 2007143	Smis = 1	501	104.3
	13 CA	Constant	269	346
		Perie Cass Listinates (CES)	269	346
		Jaens	FULL	12 PMF

loh No	10853	Sheet <u>20</u> of <u>3/</u>
	INSTANTE PEND DATE	Date 10-27-80
Subject	HIPPRILIC - HYDROLOGY	By==== Ch'k. by

DAN FAILURE ANACYSIS

ASSUMPTIONS

I THE WHITER LEVEL IN BOTH PEND*/+ PEND* 2, IS AT
TOP OF DAM, ELECHTICAL ILL.S, JUST PEIDE TO DAM
FINICES. ALSO THE INITIAL STORME, JUST PRIOR TO
DAM FINISE WILL BE ASSUMED EQUAL TO THE
COMBINIED STORMSE OF BOTH PENDS.

- 2) THE DISCHMEGE JUST PRIOR TO DAN FAILURE IS
 FULL SPILLKINY CHPACITY, 305 CFS.
- 2) BREIKH WIDTH (N) IS EQUAL TO 40% OF EFFECTIVE DAN LENGTH APPROXIBILIZEY EQUAL TO 250 FEET, No = 100 FT.

Penu Discuraçõe AT TINE OF DAN FANCEE

OF: 927 W Jg 70

WE - BREACH WIDTH

g = ACCERENTION DUE TO GRAINITY

Y = TOTAL MEIGHT FROM LEVER PORE (TOP OF DAY) TO THE

DOMNSTRONT TOE OF THE DAY, 26 FT

Q = 927 (100) \[\int 32.2 \] (26) \[26 \]

Q= 22,290 CFS

DISCHMEGE JUST PRIOR TO DAM FAILURE EQUAL 305CFS.

TOTHL DISCHMEGE WHEN DAM FAILS = 22,290 +305=22,595 CFS

Job No. 90853	Sheet <u>2/</u> of <u>3/</u>
Project Lumere Perso Den	Date <u>10-28-80</u>
Subject Manuel - Hancesco Y	By

Dan FARLUNG HIMLYSIS

DOWNSTROM OF DAM, THE "RULE OF THUNB" GUIDANCE FOR

ESTIMATING DOWNSTROM DAM FAMORE HYDROGRAPHS, AND

STARE - DISCAMRGE CURVES DEVELOPED BY USING PLANNINGS

EQUATION, WILL BE UTILIZED TO DETEXAME THE EXPECTS ON THE

FRAN MANE AS IT MOVE DOWNSTROAM. TYPICAL CROSS-SUTIONS

THRON DURING THE MEDD ASPRETION AND FROM CONTOOR

MARE CETAMORPEON THE VERNOUT STATE HIGHWAY DEPARTMENT

MILL BE USED IN CONJUNCTION WITH PLANNINGS EQUATION

TO DEFECT THE STARE-DISCAMPLE CURVES.

MANNINGS EQUITION

Q: LAG HR SISSIZ

'N' = COMPOSITE "N" VALUE

H = MESS

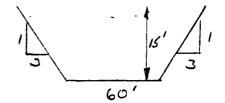
R = SIP

S = SLOPE OF ROXH

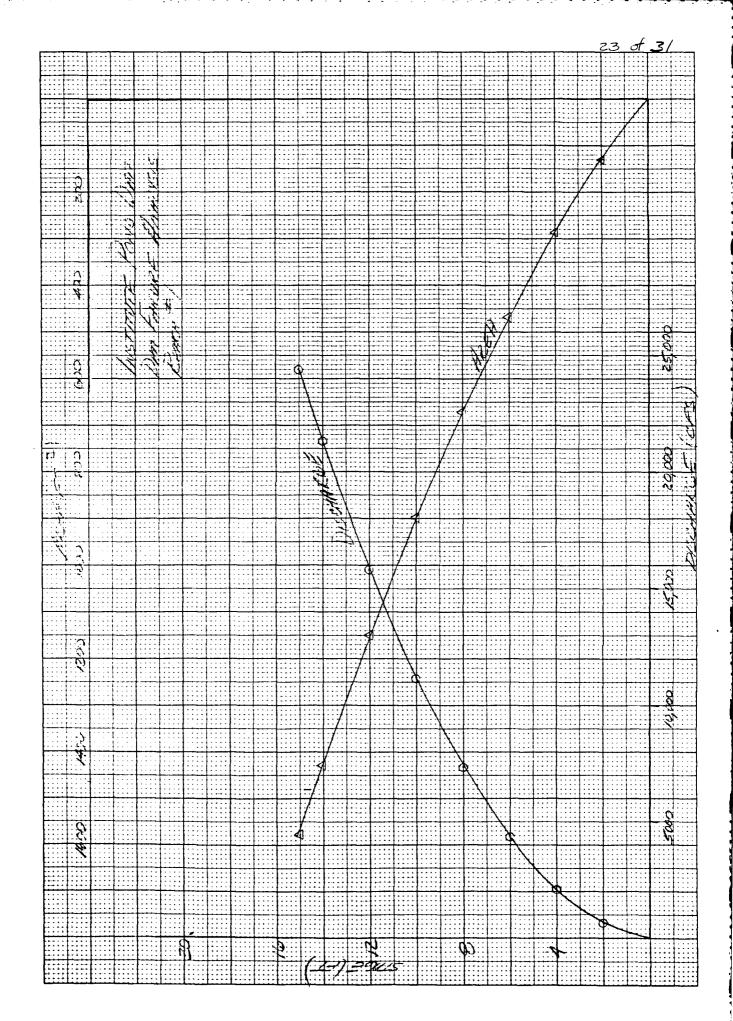
Job No. 90853	Sheet <u>22</u> of <u>_3/</u>
Project LUSTITUTE Dan POND	Date 10-28-80
Subject Marineres - Marice of Y	By <i>CTI</i> Ch'k. by

Dan Fricure Himissis
Reach #1

LENGTH 550 FT Scare = 0.024 annent in = 1.07 9-3.298AR3



Derry	Pu	23	Phent	a
2	66.9	1.54	/32	670
4.	85.3	2.25	288	2139
6	97.9	2.84	468	4-381
8	110.6	3.33	672	7384
10	123.2	3,77	900	11,180
12	125.9	4.16	1152	15,807
14	148.5	4.52	1428	21,309
15	154.9	4.69	1575	24,401



ubois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 20853	Sheet <u>24</u> of <u>3/</u>
Project LACTITUTE FOND DATE	Date 10-28-80
Subject Arpennics - Awarday	By I Ch'k. by

Dm FAILURE HIMINISIS

LEDCH #Z

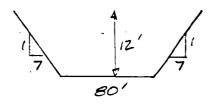
LENETH = 600

SLOPE = 0.0059

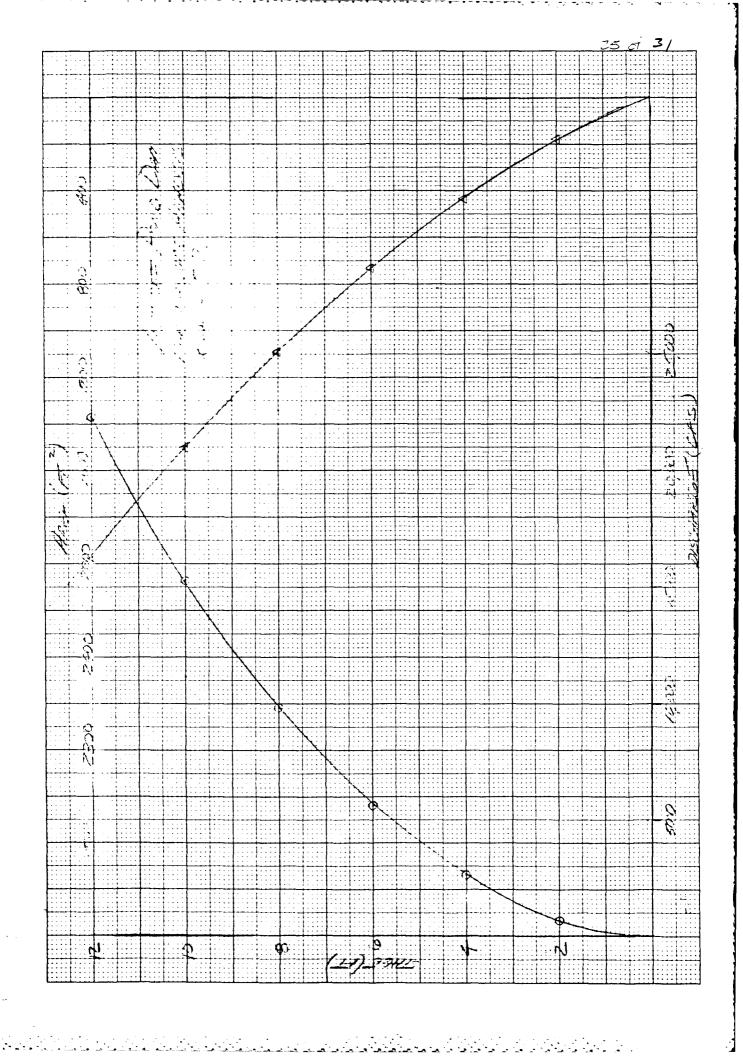
CONPOSITE "N" = 0.04

Q: 1.49 1/2 5/2

Q: 2.86 AR35



Deeth	Po	P3/2	Aren	Q
2	108.3	1.4	180	723
4	136.6	2.16	432	2663
6	164.9	2.70	732	5659
E	193.1	3.17	1088	9857
10	2214	3.58	1500	15,369
12	249.7	3.96	1968	22,306



Job No	10653	Sheet <u>26</u> of <u>3/</u>
-	MENTER POUR DAIL	Date 10-29-80
	Hormics - Hioriceci	By <u>= 47/2</u> Ch'k. by

Don FAILURE MUNCHEIS (CON'T)

ROSCH #3

LENGTH = 300 FT

LORN* 3 INCLUDES THE CULVERT WHICH CRESSES

TOWN HUMANN *122. THE CULVERT IS A CONCRETE-MECH

MINON IS EFTX 6.5FT (SAMIXEISE)

THE DECRINESE THROUGH THE COLCLET AND OVER THE ROAD WILL BE CHECULITED TO BETHIN STREES FOR THE WOMENTY.

THE WERR EQUATION WILL BE USED TO NOWELLED THE FECON CACK THE PROBLE

G. CLH32 NECONE C= 2.5 CHACTIVE WEIR LONGTH = 275 FT

Q= 687.5 H³²

H Q STREE DISCHARGES THROUGH THE CONVEXT

1 688 NS NICL BE MAPROXIMATED FROM HORMOUR

2 1945 12.5 NICL BE MAPROXIMATED FROM HORMOUR

3 3572 13.5 CHMETS (SEE FOLLOWING PHICE)

4 5500 14.5

5 7686 15.5

6 10,104. 16.5

•

 $\frac{1}{1}$

.

SUB-AREA RUNCFE COMPUTATION DAM E1 ICOMP JPRT 0 HYCROGRAPH TRSDA 0.00 TRSPC LOCAL 0.000 ISNOW PRFCIP P12 111.00 1 0.00 100.00 518KS 0.00

UNIT HYDROGRAPH DATA

TP= .21 CP= .63 NTA= 0

RECESSION DATA
ORCSN= -10 RIIOH= 1.50
ORCSN= -210 RIIOH= 1.50
ORCSN= -210 RIIOH= 1.50
ORDINATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 1.58 AND R= .86 INTERVALS

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .21 FOURS, CP= .63 VCL= 1.00
18. 5. 1. 0.

IHYDĢ

STRKH 0.00

SPFE 0.00

DLTKR 0.00

RIICL

RATES. LAG= 0. COMMP | 1. COMP | 1. COMMP |

;.;

-4

1456123456123456123456	11199988877746666677555	8769630864197642097643.	18/7/08/40/67/5 009988877766688889444			-	
SUM			18228.				
PEAK 692.	6-HOUR 416. 16.83 206.	24-HOUR 127. 20.48 251.	72-HOUR 127. 20.48 251.	TOTAL	VOLUME 18228. 20.48 251.		

CFS INCHES AC-FT

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6-HOUR
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16.92
208.
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18553.
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AVG
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STORAGE = OUTFLC#=
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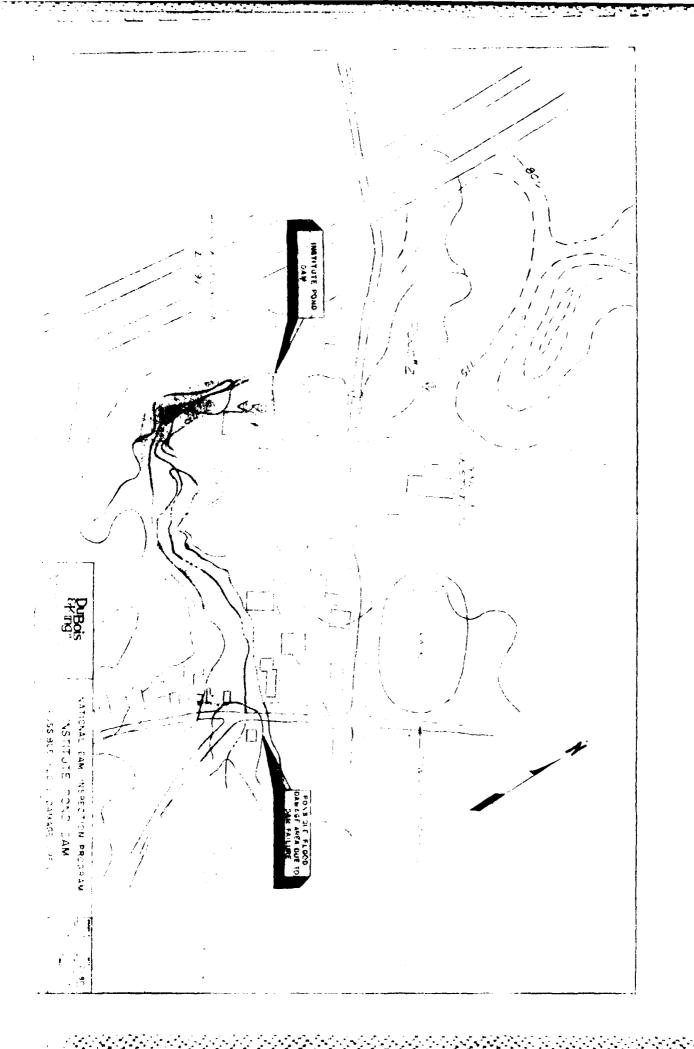
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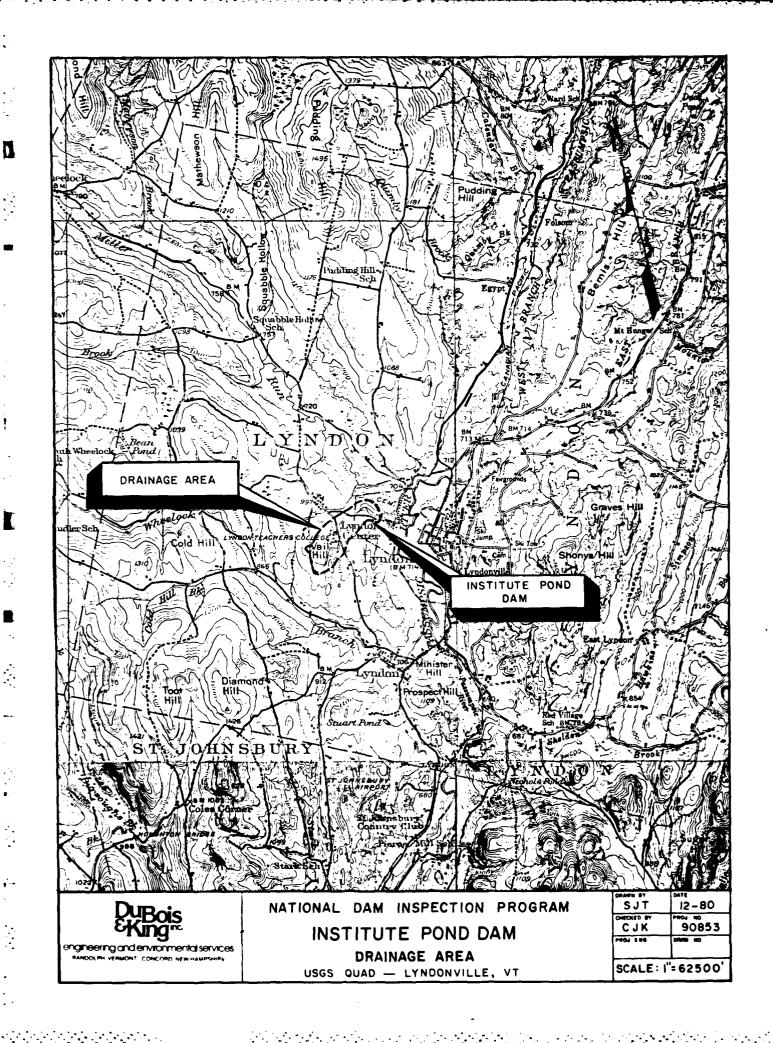
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MEC-1 VERSION DATED JAN 1973 UPDATED AUG 74 CHANGE NO. 01 INSTITUTE POND DAM U.S. ARMY CORPS OF ENGINEERS LYNDON, VERMONT 1980 DESIGN STORM SUB-AREA RUNOFF COMPUTATION INSTITUTE POND 32 RUNOFF COMPS ISTAG ICOMP IECON ITAPE JPRT INAME JPLT SNAP TRSDA TRSHC ISNOW I UHG IHYDG RIICL CNSTL TP= 1.25 CP= .63 NTA= 0 RECESSION DATA

STRIG** 1.00 GRCSN** -.10 RTIOR** 1.50

PROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC** 8.66 AND R** 6.76 INTERVALS UNIT HYDROGRAPH 41 END-OF-PERIOD URDINATES. LAG= 1.26 FOURS. CP= .64 VOL= 1.00
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DuBois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES

Job No. 90853	Sheet <u>3 / of 3 /</u>
Project Justine Pero Din	Date _//- 14-80
Subject Henrice - Himaco	By Ch'k. by

Don France Manuer (con ;)

Corcusions

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Durois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

loh No		Sheet 30 of 3/
	LUCKETT POLICE PINC	Date 10-30-80
	HIMMITTES - HUXCLCCOY	By Ch'k. by

Dan FANDER HUNYSIS

RUKH 2 LONGTH = 300 FT

ERUKH G. - 8749 CFS - STREE = 15.8 FT

VISINGE NT 15.8 FT - AKCH = 2420 , T = lacune = 16.7 K-FT

EXPIRE G. 8749 (1- 16.7) = 5211 CFS - STREE = 14.3 FT

WENTER HT 14.3 FT - MELLI = 2090 FT = lacune = 14.4 K-FT

EXERCH G. - 8749 (1- 15074.4/2) - 5455 - STREE = 14.4 FT

Some of From Mare in Rose 1 = 14.4 FT

Some peror to From More in Renew 3 = 7.4 FT

THE SPICE IN LUCH*3 MEXENTES DUE TO THE CULVEST CHISER TOWN HISMANY *122, WHICH SHOWNES A DAIN TYPE STRUCTURE. THE SPICE IN THE VICINITY OF TOWN HOMANY 122 WAS CHICOCHTED TO BE 3.9 FT OVER THE ROAD. DOWNSTROM OF THE CULVEST THE MEET IS UNINHABITED, AND REMAINS UNINHABITED WITH REACHING THE PHSOURCE RIVER.

Job No. 20853	Sheet 29 of 3/
Job No. <u>1885 3</u> Project <u>Institute Pous Print</u> Subject <u>Hoenunes - Honoras</u>	Date <u>/0 - 3 - 80</u> By <u>& C</u> h'k. by
Dur FINCUSE PHYMENSIS (CCN +	1
RENCH # / LEXETH STOFT	
BREIKH Q7 = 22,595CFS - STAGE = 1	14.4FT
EXENCH GD (TRING) = 22,595 (1- 41,3) =12,4	19 - STIGE = 10.6 PT
"large in Men - New = 975 FT -	- Vacane = 12.3 HE FT
BREMEN OF = 22,595 (1- 18.6+12.3/2) = 14,	
Since OF FROM MINE IN RE	PARH = 11.3FT
Since PRICE TO FLOCK WHY	ENKEREN #1 = 1.1PT
Reach # 2 Lewsth: 600	
EXECULA 0 = 14,142 CFS = STAGE 9.6	PFT
Vernoe m 9.6 FT - Mein	= 1420 m = Vacure = 19.6x-FT
Paris Of (TRINC) = 14192 (1- 196) = 7	431 crs - Smae 6.817
"/since HT 6.8 FT - AKIN = 870	DET = VOCUNE = 11.9 MC-FT
BRUREN O = 14-14-2 (1- 19.6+11.9/2) =	8749 cFs
STACE OF FLOOD WHUE IN KENCE	1 #2 = 7.5 FT

STUGE PRIOR TO FLOOD WHIE IN ROKH #2 = 1.4AT

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HYDRAULIC CHANTS FOR THE SELECTION

NOTE: CONPUTATIONS TAKEN

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SUMMARY & RECOMM	COMM	ENDATIONS	LIONS:													

Figure 7

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MEC-1 VERSION DATED JAN 1973 UPDATED AUG 74 CHANGE NO. 01 INSTITUTE POND DAM U.S. ARMY CORPS OF ENGINEERS LYNDON. VERMONT 1980
DESIGN STORM NHR NMIN IDAY ING IMIN METHC IPLT IPRT NSTAN SUB-AREA RUNGFF COMPUTATION INSTITUTE POND 32 RUNOFF COMPS ISTAG COMP IECCN ITAPE JPLŢ JPRT INAME TAREA RATIC .500 рниı ISNOW PRECIP DATA R12 R24 19.50 100.00 111.00 120.00 0.00 0.00 STRKS RTIOK ERAIN 0.00 STRTL .63 CHSTL RTICL ATAG HQARQORGYH TINU TP= 1.25 CP= .63 TATA CP. 1 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SYDEP CP AND TP ARE IC= 8.66 AND R= 6.76 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAGE 1.26 FOURS, CP= .64
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RECESSION DATA

RECESSION DATA

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND THE ARE TC= 1.50

UNIT HYDROGRAPH 6 END-OF-PERIOD ORDINATES, LAG= .21 FOURS, CP= .63 VOL= 1.00

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CFS INCHES AC-FT

RUNOFF SUMMARY+ AVERAGE FLOW

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APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

8C8 A PRV/FED z DAY | MO | YR REPORT DATE 310EC80 **POPULATION** FEO R 3 MAINTENANCE 2 3 0 FROM DAM LATITUDE LONGITUDE (WEST) 4452.2 7201.1 z 0 AUTHORITY FOR INSPECTION 3 **CONSTRUCTION BY** 7 T **PIST** 3×0 L> NAME OF IMPOUNDMENT Š IMPOUNDING CAPACITIES INVENTORY OF DAMS IN THE UNITED STATES NEAREST DOWNSTREAM CITY-TOWN-VILLAGE 92-367 0000 OPERATION 7 LYNDON CENTER 3 TWSTITUTE ي V1 0xR INSPECTION DATE REGULATORY AGENCY 30SEP90 ENGINEERING BY 5 NAME Θ REMARKS REMARKS T A 3 2 CZOG CONSTRUCTION UNKNOWN VOLUME OF DAM ◉ INSTITUTE PURPUSES RIVER OR STREAM **©** 302 POPULAR NAME 305 TITELS PRODUCE TREETE € INSPECTION BY CONCH DIST. F TAPPASSUAPSIC \mathbf{e} YEAR COMPLETED 1011 @ STATE COUNTY DIST. STATE COUNTY DUNOIS A KING INC Θ ÷ OWNER 0 23-4ESI-ETIC • DESIGN TYPE OF DAM Θ =: 250 (e) HON 500 PECIONEASIN € 1.430 . n : 0 % -STATE DENTITY DIVISION 218 25.0 ϵ

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